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THESIS

A COMPARISON OF THE USAF PROJECTED A-10
EMPLOYMENT IN EUROPE AND THE
LUFTWAFFE SCHLACHTGESCHWADER EXPERIENCE
ON THE EASTERN FRONT IN WORLD WAR TWO

by

Lonnie Otis Ratley III

March 1977

Thesis Advisor:

R. H. S. Stolfi

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A Comparison of the USAF Projected A-10 Employment
in Europe and the Luftwaffe Schlachtgeschwader Experience
on the Eastern Front in World War Two

by

Lonnie Otis Ratley III
Captain, United States Air Force
B.A., Florida State University, 1967
M.P.A., Golden Gate University, 1976

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requirements for the degree of

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Author

Approved by:

Thesis Advisor

Second Reader

Chairman, Department of
National Security Affairs

Dean of Information and Policy Sciences

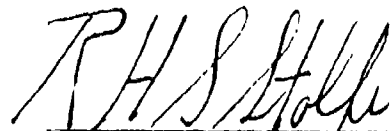
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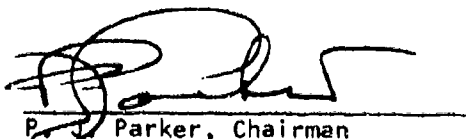
This report was prepared by:



R. H. S. Stolfi, Professor
Department of National Security Affairs

Reviewed by:

Released by:



P. J. Parker, Chairman
Department of National Security Affairs



Robert R. Fossum
Dean of Research

ABSTRACT

This study was conducted to analyze the methods, successes, failures, and operational performance of the German Luftwaffe anti-tank aircraft and units in World War Two on the Eastern Front, and the possible application of the Luftwaffe experience to the current NATO air forces. The research involved interviews with former Luftwaffe officers who participated in the German Eastern campaign from 1941-45, a trip to the Bundesarchiv-Militärarchiv in Freiburg, West Germany, a trip to the Air University Library, Maxwell AFB, Alabama, in addition to participation in an anti-tank seminar held in Washington, D. C., on 14-15 October 1976.

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TABLE OF CONTENTS

INTRODUCTION	-----	9
CHAPTER I	Historical Perspective -----	35
CHAPTER II	Training and Operational History of the <u>Schlachtflieger</u> -----	44
CHAPTER III	Setting, Tactics and Historical Summary -----	52
CHAPTER IV	Airpower at Kursk -----	69
CHAPTER V	Environment 1976 -----	102
CHAPTER VI	The A-10 -----	110
CHAPTER VII	The Alternates -----	119
CHAPTER VIII	A Meeting with <u>Oberst</u> Rudel -----	138
CHAPTER IX	Conclusions -----	145
APPENDIX I	Rank Equivalents -----	158
APPENDIX II	<u>Luftwaffe</u> Unit Echelons -----	159
APPENDIX III	Penetration Performance of Tungsten-Carbide German World War Two Ammunition -----	161
APPENDIX IV	<u>Oberst</u> Rudel's Special Ammunition Characteristics -----	162
APPENDIX V	<u>Luftflotte</u> Order Establishing <u>Schlachtgeschwader</u> and Reorganizing Close-air-support units -----	165
APPENDIX VI	<u>Luftflotte</u> Order changing name of Chief of Close-air-support units to <u>General der Schlachtflieger</u> -----	167
APPENDIX VII	Soviet Divisional Strength -----	168

APPENDIX VIII	Order of the Iron Cross, World War Two -----	173
APPENDIX IX	Schematic of Control of Armored Break-through in World War Two by German Anti-tank Forces -----	174
APPENDIX X	Interview <u>Brigadergeneral a.D.</u> Paul-Werner Hozzel -----	175
APPENDIX XI	Interview <u>Oberst a.D.</u> Hans Ulrich Rudel -----	185
APPENDIX XII	Aircraft Gun Systems Comparisons Chart -----	191
BIBLIOGRAPHY	-----	192
INITIAL DISTRIBUTION LIST	-----	203

NOTES TO THE READER

Throughout the text I have used German military ranks when referring to German personnel, for example Hauptmann refers to the German equivalent of a USAF captain, (see Appendix I for a complete listing of rank equivalents). The German term a.D. refers to ausser Dienst indicating an officer is on the retired list.

German Luftwaffe units were broken down into the following echelons: Luftflotte, Fliegerdivision, Geschwader, Gruppe, Staffel, and Schwarm. These units roughly correspond to the USAF: Numbered Air Force, Air Division, Wing, Squadron, Detachment or Small Squadron, and Flight, (see Appendix II for a more detailed listing). The basic unit for operational purposes was the Geschwader. A Geschwader was designated in Arabic numerals, e.g. Schlachtgeschwader 9, abbreviated StG 9. A Gruppe within a Geschwader would be designated in Roman numerals, e.g. IV (Pz.)/StG. 9 referred to the IV (anti-tank) Gruppe of Schlachtgeschwader 9. A Staffel within a Geschwader (not a Gruppe) would be referred to in Arabic numerals, e.g. 10 (Pz.)/StG. 2 designated the tenth anti-tank Staffel of Schlachtgeschwader 2.

Unit commanders were referred to as Schlachtgeschwaderkommandore, Gruppenkommandeur, or Staffelkapitän for Geschwader,

Gruppe, and Staffel respectively. Geschwader were always prefaced with the type of unit, e.g. Stukageschwader for a dive bomb Geschwader. Personal rank for officers commanding at the same level would often vary considerably due to attrition and the tendency in the Luftwaffe to promote young and successfully "blcoded" combat officers to command positions, regardless of tenure. It was not uncommon for an Oberstleutnant, Major, or Hauptmann to command separate Gruppen within the same Geschwader.

I have retained operational code names in the German original, e.g. ZITADELLE (Citadel). The English translation will appear in parenthesis after the first mention of the operational code name, thereafter I site the German original only.

INTRODUCTION

As one looks at the relative balance of NATO forces versus Warsaw Pact forces in Europe, a cursory observation of the order of battle, illustrates what appears to be a massive communist advantage. The overwhelming numerical superiority of the Warsaw Pact's conventional forces is indicated by the following figures:

Disposition of Forces 1975¹

Divisions*	NATO	Warsaw Pact + 3 W. USSR Regions	
Divisions*	27	58	30
Tanks	6100	19,000	8,000
Tactical Aircraft	1700	2,460	1,290

*See Appendix VII for Soviet Divisional strength

It is of further importance to note that of the Soviet armoured divisions available, 20 are located in the German Democratic Republic (East Germany), constituting the heaviest concentration of Soviet forces outside the Soviet Union. The Warsaw Pact's reliance on armour has been increased dramatically during the last 5 years. The number of tanks

¹Press and Information Office of the Government of the Federal Republic of Germany, White Paper 1975/1976: The Security of the Federal Republic of Germany and the Development of the Federal Armed Forces, p. 33, Federal Minister of Defence, 1976.

in a Soviet motorized rifle division has increased from 188 to 266 during the 1970 to 1975 time frame.² The total number of battle tanks in the Warsaw Pact has also increased from 13,650 in 1970 to 19,000 in 1975.³

If one contrasts the present order of battle to the situation existing on the Russo-German Front in World War II, several noteworthy similarities appear:

Disposition of Forces 22 June 1941
(start of BARBAROSSA*)⁴

	<u>Germans+</u>	<u>Russians</u>
Divisions	145	213
Aircraft	1,945 ⁵	4,000
Tanks	3,330	22,000 ⁶
Combat troops	3,200,000	4,500,000

*Code name for German Operations Plan for the attack on the USSR.

+Exclusive of German allies which did not play a prominent part in the initial offensive.

As one can see, the parallels are more than casually significant. The point being, that in 1941, with a marked numerical

²Ibid., p. 35.

³Ibid., p. 35.

⁴Philippi, A. and Heim, F., Der Feldzug Gegen Sowjetrussland, 1941-1945, p. 36-7, W. Kohlhammer, 1962.

⁵Bekker, C., The Luftwaffe War Diaries, p. 552, Ballantine, 1969.

⁶Milsom, J., Russian Tanks 1900-1970, p. 59, Stackpole, 1971.

inferiority in personnel and materiel, the Wehrmacht was still able to mount a successful offensive against the Soviet Union. A more detailed analysis of the initial German offensive will reveal that Germany came within a "hairsbreadth" of knocking the USSR out of the war in the Summer of 1941. A review of German strategy and tactics is not the purpose here. The significant point is that a ratio of forces existed between the Germans and Russians in 1941 which is strikingly similar to the ratio which exists now between NATO and the Warsaw Pact. The Germans were on the offensive, and it can be logically assumed that without the delays and vacillations of the civilian leadership at that time, the German army could have successfully terminated the war with Russia based on a continuation of the offensive from the Smolensk area toward Moscow in early August 1941. Of course the margin of error was, and still is, critical. The Germans could not afford the mistakes in strategic misdirection in 1941 and still effect a winning campaign. Such is a lesson of history.

In formulating NATO strategy today, one can draw on the successful aspects of German operations in World War II. One of these successful aspects was the use of close-air-support aircraft in an anti-tank role. In Russia during World War II the Luftwaffe was able to counter armoured thrusts on the



"The Problem"

This Soviet T-34 Tank approached within 20 meters of the German anti-tank crew before their 37mm anti-tank cannon was able to penetrate the tank's armour. Photo from Carell's, Unternehmen Barbarossa.

ground, from weapons' systems in the air. Consider the fact that on 8 July 1943, in Karachev, Russia, a Luftwaffe Gruppe destroyed an entire armoured brigade leaving 50 Soviet main battle tanks (T-34's) burning on the battlefield, with no assistance from friendly ground personnel.⁷

As the USAF prepares for the deployment of A-10 close-air-support aircraft to augment NATO forces, one senses that a full comprehension of German air-to-ground anti-tank tactics from World War II might possibly prove most useful in developing NATO air tactics for contemporary Europe. The relative comparison of forces has already been made; the parallel does, however, not end there. Studying the actual conduct of operations on the German Eastern Front in World War II and the likely situation in which NATO would find itself given hostilities in Europe, the analogous situation of a mass army of personnel and material (especially tanks) being countered by technology and efficiency is apparent. An overwhelmingly technically oriented military force with complex modern equipment and aircraft finds itself pitted against a numerically superior foe with large formations of simple, rugged, armoured vehicles. A review of the entire

⁷Carell, P., Scorched Earth, the Russian-German War 1943-1944, p. 76, Little, Brown, 1970.

German tactical environment is not appropriate here, however, a detailed examination of the aircraft/tank battle will be undertaken. Looking at the Luftwaffe experience on the Eastern Front in World War II, much material can be extracted which can be applicable to Europe in the 1980s, and therefore effect a more efficient use of our aircraft resources.

The ultimate course of the war in the East hinged on many factors other than the confrontation of aircraft against tank, however, the anti-tank air campaign was in itself tremendously successful and portions thereof can be applied to the European environment in the 1980s. The critical fact emerges that with extremely limited resources the Luftwaffe Schlachtgeschwader* were able to successfully engage armoured units on the ground. The success of the Schlachtgeschwader was far in excess of their numbers or relative cost. Oberst Hans-Ulrich Rudel, for example, personally accounted for 519⁸ Soviet tanks with his JU87G Stuka** Admittedly Rudel was not the norm, however, the implications of one man

*Schlachtgeschwader - close-air-support Geschwader.

⁸Bekker, C., The Luftwaffe War Diaries, p. 438, Ballantine, 1969.

**Stuka - Sturzkampfflugzeug, or dive bomber aircraft, used synonymously for the JU87.

destroying over 500 tanks (enough for 3 Panzer divisions in 1941) from the air is obvious to the position of NATO in Europe today.

As previously mentioned, the highly qualitative and technically oriented Wehrmacht of 1943 opposing the massive Russian formations is, in many respects, strikingly parallel to the present situation of the NATO forces opposing the Warsaw Pact forces. On one side an army numerically superior in personnel and equipment, emphasizing manpower and huge concentrations, attempting to overwhelm an inferior number of highly trained and qualitatively superior forces.

Each side has certain historical characteristics which have not changed. For example the Russians relied and still rely, on railroads as their basic and foremost medium of logistics support. One can further observe the consistent Russian tendency to deploy large formations of simple, rugged and reliable equipment to outfit their ground forces. The Soviets have also tended to make extensive modifications to existing weapons' systems, as opposed to opting for completely new designs. The Russian Armies have always been, and continue to this day, to be characterized by weak logistics systems, as compared to the resources delegated to combat formations. To put it more bluntly "the Russian Steam Roller runs out of steam in a hurry." The choke point

of the Russian-Polish border is most important as the railroad gage changes and all freight must be unloaded and then reloaded onto other freight cars.

The West, on the other hand, has placed more emphasis on the qualitative nature of its armies. The resources are not available in Europe to outfit mass armies on the Soviet model. As such, the margin of error for Western armies has always been much smaller than that of the Russians. The invading armies of Charles XII, Napoleon I, Kaiser Wilhem II, and Hitler all shared this common characteristic, so does NATO.

Nowhere is the disparity in forces more apparent than in the number of tanks deployed with the Warsaw Pact versus those deployed with NATO. Current estimates run from 6100⁹ to 7300¹⁰ for NATO opposing 19,000¹¹ for the Warsaw Pact. The Warsaw Pact figure should be increased to 27,000 if the three Western Military Districts of the USSR are included. The Wehrmacht was faced with a similar problem in 1941, which became progressively worse as the war continued. The

⁹White Paper 1975/1976, Op. Cit., p. 33.

¹⁰The International Institute for Strategic Studies, Strategic Survey 1975, p. 63, IISS Publications Department, 1976.

¹¹White Paper 1975/1976, Op. Cit., p. 33.

Wehrmacht had 3330¹² tanks available in June 1941 for the invasion of Russia. The Wehrmacht Panzer forces were opposed by roughly 22,000 to 24,000¹³ Russian tanks, according to English sources. German sources vary from a figure of 10,000¹⁴ deployed facing the Wehrmacht in Western Russia, to a Russian advantage of 4 to 5 times the 3330 German tanks.¹⁵ Soviet sources vary from a low of 15,000 to a high of 24,000.¹⁶ Taking an average figure of 20,000, a German-Russian tank ratio would be 1:6. Comparing the German-Russian tank ratio to the 1:4½ NATO-Warsaw Pact ratio, one can see the need for effective anti-tank weaponry in Europe today.

A graphic illustration of the similarities between NATO versus Warsaw Pact and Wehrmacht versus Red Army will aid in clarifying the parallel in the form of an analogy. The setting will of course be the same. The weather conditions can be expected to be the same. The location of the USSR

¹²Philippi and Heim, Op. Cit., p. 38.

¹³Milson, Op. Cit., p. 59.

¹⁴Philippi and Heim, Op. Cit., p. 39.

¹⁵Von Tippleskirch, Geschichte des Zweiten Weltkrieges, p. 179, Anthenäum, 1959.

¹⁶Milson, Op. Cit., p. 59.

has not changed and the geography is essentially the same as it was during the war. (See figure 1 on the following page.)

The immediate point that would come to even the casual observer's mind is the fact that the Germans lost the war. This is indeed the case, however, the Oberkommando der Wehrmacht's (hereafter cited as OKW) plan BARBAROSSA came shockingly close to defeating the USSR in the late summer of 1941 and the advent of the worst winter in 2½ centuries¹⁷ in 1941-42 heavily favored the defending Russians, with the associated slowing down of mobile forces. One must also consider the huge territorial resources of the USSR with over 8.6 million square miles of territory and its huge population advantage (Russia in 1939 200,000,000 versus Germany with 80,000,000), in light of these figures the near German victory in 1941 is worthy of more study in of itself. Fortunately for the Russians, Hitler intervened in the strategic direction of BARBAROSSA, hesitated and eventually changed the Schwehrpunkt* from the North/Center with the objective of Moscow to the South with the industrial and agricultural areas of the Ukraine--before switching back to Moscow.

¹⁷Stolfi, R.H.S., Chance in History, the Russian Winter of 1941-42, p. 21.

*Schwehrpunkt - point of critical emphasis, e.g. in the French campaign of 1940 the Schwehrpunkt was Sedan.

THE SETTING

Weather

Location

Geography

1976

NATO Quality

vs.

Warsaw Pact Quantity

Russian Transport Net+

% of total freight

RR 68.10*

Road 5.20

Air 1.68

Weapons

NATO

A-10 AC

w/30mm Can.

or

Similar

Tac AC

Warsaw

T-62 Tank

SAMs

SA 6

SA 7/9

AAA

23mm

37mm

57mm

Interceptor

Aircraft

1943

Wehrmacht Quality

vs.

Russian Quantity

Russian Transport Net

% of total freight

RR 85.10

Road 1.80

Air ..02

Weapons

Wehrmacht

JU 87G w/37mm

or

HS 129 w/30mm

Russians

T-34 Tank

AAA

20mm

37mm

57mm

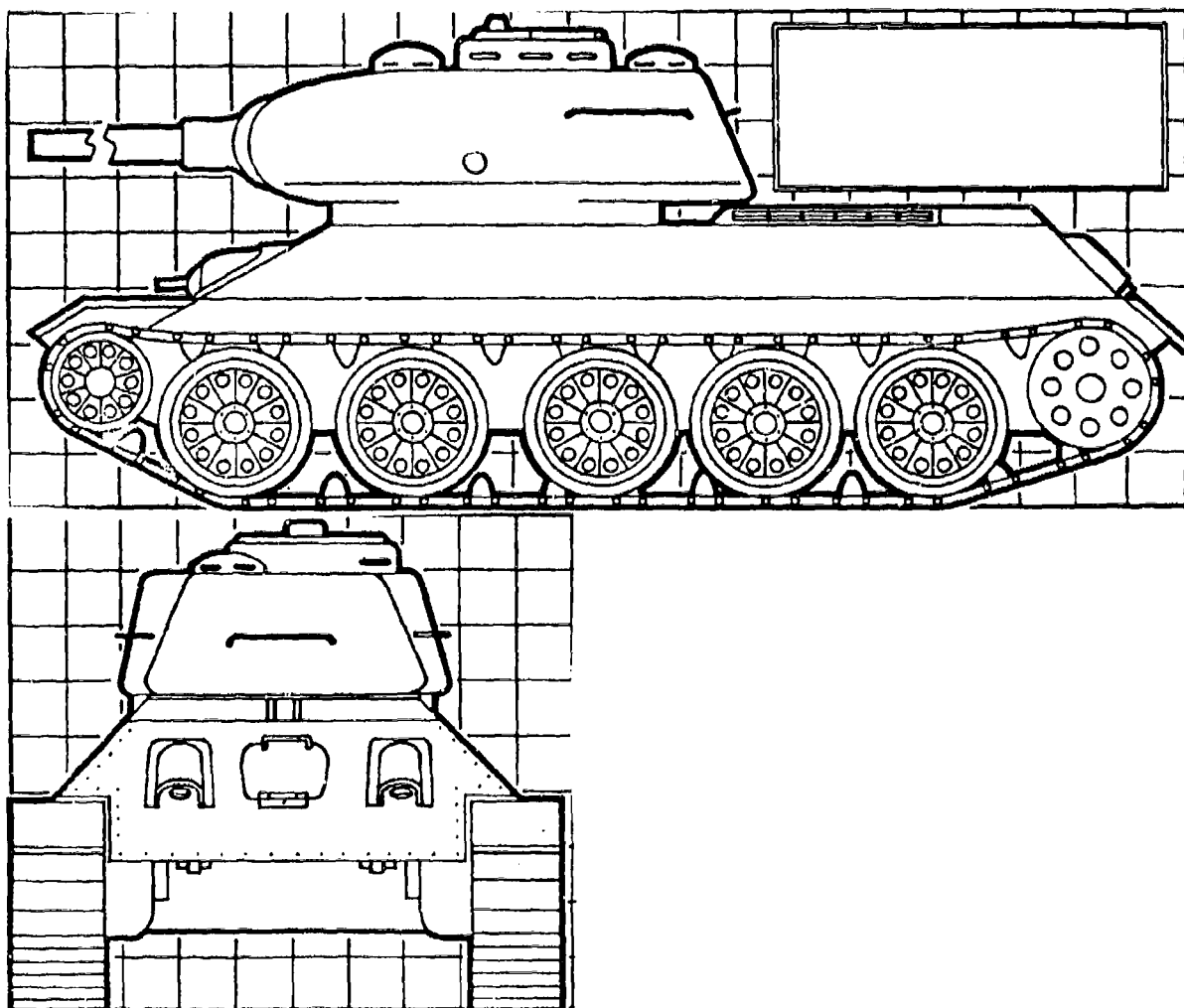
Interceptor

Aircraft

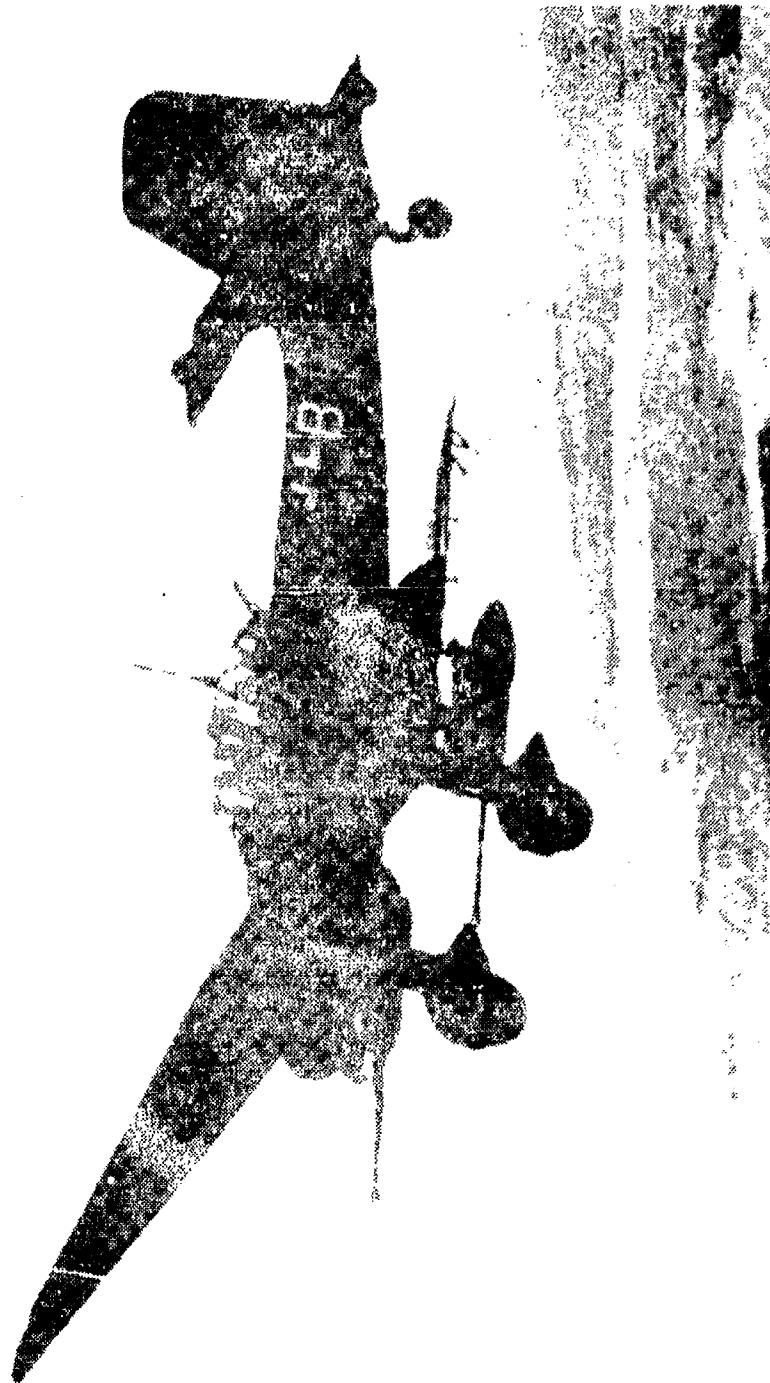
* Internal (Interregional 82.4%)

+Source: Lydolph, P.E., The Geography of the USSR, p. 552,
Wiley & Sons, 1970.

Figure 1

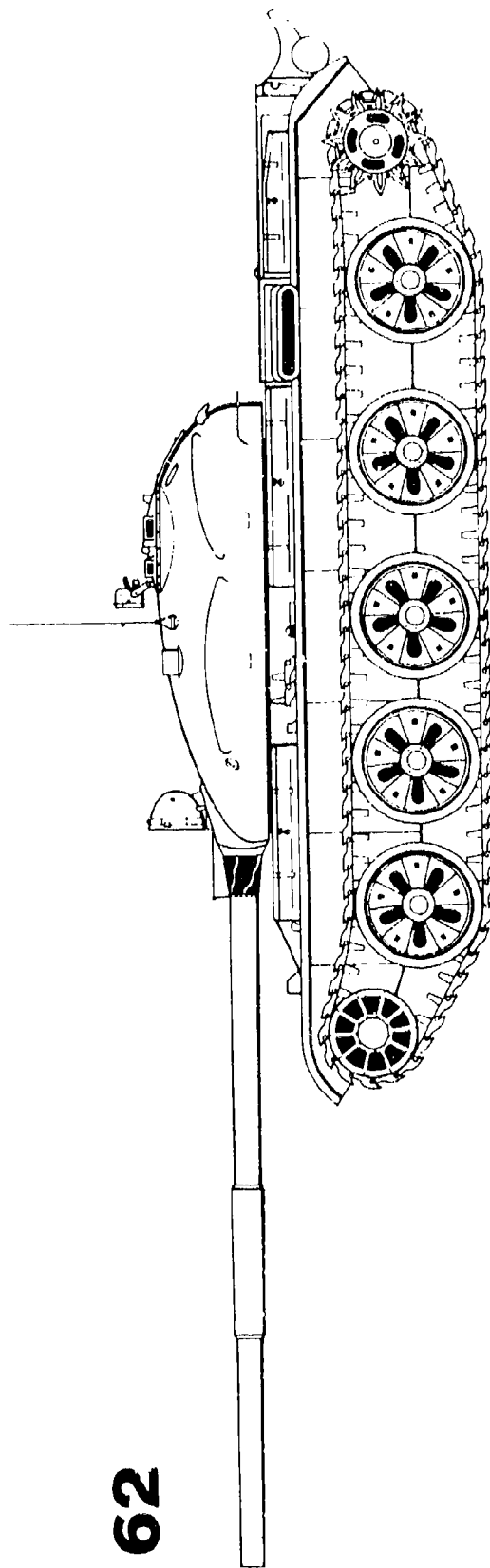


The WW II Russian T-34 Tank



The JU 87Gm Stuka
(note the 2 wing mounted 37mm cannons)

T. 62



Series-version T. 62. The particularly flat and sloped lines of this excellent tank, probably the best in the world, need hardly be pointed out, being evident from the two views. The suspension system, as usual of the CRISTIE type, is of commendable simplicity. The turret, like that of the T. 54 55 before it, is free from bulge. On the rear extremity is visible the support for the 2 supplementary fuel reserves.

T. 62 di serie. Non è il caso di far notare le forme particolarmente slunganti di questo ottimo carro, probabilmente il migliore del mondo, tanto risultano evidenti dalle due viste. Il treno di rotolamento, come al solito di tipo CRISTIE, è di encomiabile semplicità. La torretta come già quella del T. 54 55, è priva di controcatena equilibratrice. Sull'estremità posteriore è visibile il supporto per le 2 riserve supplementari di combustibile.

The contemporary Russian T-62 Tank.



The Fairchild Republic A-10

The resources situation of the Wehrmacht did not allow for a margin of error on the order of Hitler's intervention; as such BARBAROSSA miscarried and the war in the East stalemated, then slowly fell in favor of the Russians. It was during the phase of essentially defensive operations by the Wehrmacht, that the Germans made extensive use of their Schlachtgeschwader to combat the ever increasing number of Soviet tanks.

Again the critical reader would point out that there are vast differences in weapons' systems acquired with 30 years of technology and progress since World War II. But are they so different? Comparing the T-34 of World War II and the T-62 of today, one can observe--from the attacking aircraft's vantage point--striking similarities:

Comparison of Soviet T-34 & T-62¹⁸

<u>Specifications</u>	<u>T-34/85 I & II</u>	<u>T-62</u>
Weight-Metric Tn	31.5	37.5
Height-feet	7.8	7.3
Length-feet	19.8	21.6
Width-feet	9.8	11.0
Max speed MPH	31	34.4
Eng./type/HP	12cyl/diesel/500	12cyl/diesel/700
Cooling	Water	Water
Wheels per side	5 Lg. bogie	5 Lg. bogie
Aux Armament	2 X 7.62MG	1 X 7.62MG
Ammunition main	45	45
Armour:		
Hull rear	45mm	60mm
Hull roof	18-22mm	30mm

¹⁸Milson, Op. Cit., p. 172-174.

The T-62 is overall much more heavily armoured than the T-34, however, from the airman's point of view the increase in armour is essentially irrelevant. Referencing the 2 diagrams the reader will observe that the hull roof of the T-34 is from 18-22mm thick, while that of the T-62 is only 30mm thick. Similarly the hull rear side of the T-34 is 45mm thick and the T-62 only 60mm. The German armour piercing Wolfram (tungsten-carbide)¹⁹ centered 37mm ammunition carried on the JU87G Stuka with the Flak 18 cannon, had no difficulty penetrating the above mentioned sections of the T-34 even at dive angles of 30 degrees and release altitudes of 1000 feet slant range.²⁰ (See Appendix III). The A-10 with the 30mm GAU 8 cannon has demonstrated a similar capability against a variety of tanks, including the T-62, in conjunction with weapons' testing at Nellis AFB, Nevada, (USAF Fighter Weapons' Center).²¹

As mentioned previously, the Schlachtgeschwader were more active from 1943-45, than in the early phases of the war. Victory eluded the Wehrmacht in 1941 and the odds

¹⁹Rudel, H.S., Stuka Pilot, p. 76, Washburn & Sons, 1953.

²⁰Karlsruhe Document Collection, K113.3019-4, frame 1826, unpublished, 1953.

²¹Aviation Week and Space Technology, p. 15, 5 January 1976.

against an eventual German victory declined after the winter Battle of Moscow in 1941. The brief German resurgence in the summer of 1942 was dimmed by the failure to take Stalingrad in late 1942 and the eventual German defeat there in February 1943. The last chance for a German victory passed with the unsuccessful termination of the ZITADELLE (Citadel) operation in July 1943. It is generally agreed that after this point, the best the Germans could hope for would be a draw with the Russians. Total victory was no longer a possibility for Germany. This is not intended to imply that the war was lost--it only means the war could no longer be totally won by Germany. Two possibilities, therefore, presented themselves: 1) eventual defeat for Germany, or 2) a war of attrition effecting a draw, with the realization by the Soviets that the price of victory would be too high. At this point (after ZITADELLE) the German margin of error was not merely critical, it was the key on which the survival of the Third Reich hinged.

An examination of the order of battle after ZITADELLE will clarify the point. Army Group South was in a typical position:

ARMY GROUP SOUTH ORDER OF BATTLE (20-21 August 1943)²²

²²Von Manstein, E., Lost Victories, p. 457, Henry Regnery, 1958.

ARMY GROUP SOUTH ORDER OF BATTLE (20-21 August 1943)

<u>Ger. Army Formations</u>	<u>Area of Front</u>	<u>Divisions: Formed Strength</u>		<u>Opposed by Russian Formations:</u>
6th Am.	155 mi	10Ify. 1Pz.	3 1/2 1/2	31Rf.Div. 2Mec.Co. 7Ar.Bg. 7Ar.Reg. TT=400
1st.Pz.Am.	155 mi	8Ify. 3PzG.	5 1/2 1 1/4	32Rf.Div. 1Ar.Co. 1Mec.Co. 1Ar.Bg. 6Ar.Reg. 1Cav.Co. TT=220
8th Am.	130 mi	12Ify. 5Pz.	5 3/4 2 1/3	44-5Rf.Div. 33Mec.Co. 3Ar.Co. 11Ar.Bg. 16Ar.Reg. TT=360
4th.Pz.	170 mi	8Ify. 5Pz.	3 2	20-22Rf.Div. 1Mec.Co. 5Ar.Co. 1Ar.Bg. 1Ar.Reg. TT=490

Southern Army Gp.	610 mi	38Ify. 14Pz.	18Ify. 6Pz.
-------------------	--------	-----------------	----------------

Key:	Pz.	-Panzer	Rf.	-Rifle
	Ar.	-Armoured	TT.	-Total Tanks
	Ify.	-Infantry	Co.	-Corps
	PzG.	-Panzer-Grenadier	Div.	-Division
	Cav.	-Cavalry	Bg.	-Brigade
	Med.	-Mechanized	Reg.	-Regiment

The basic German defensive strategy was articulated by Generalfeldmarschall von Manstein:

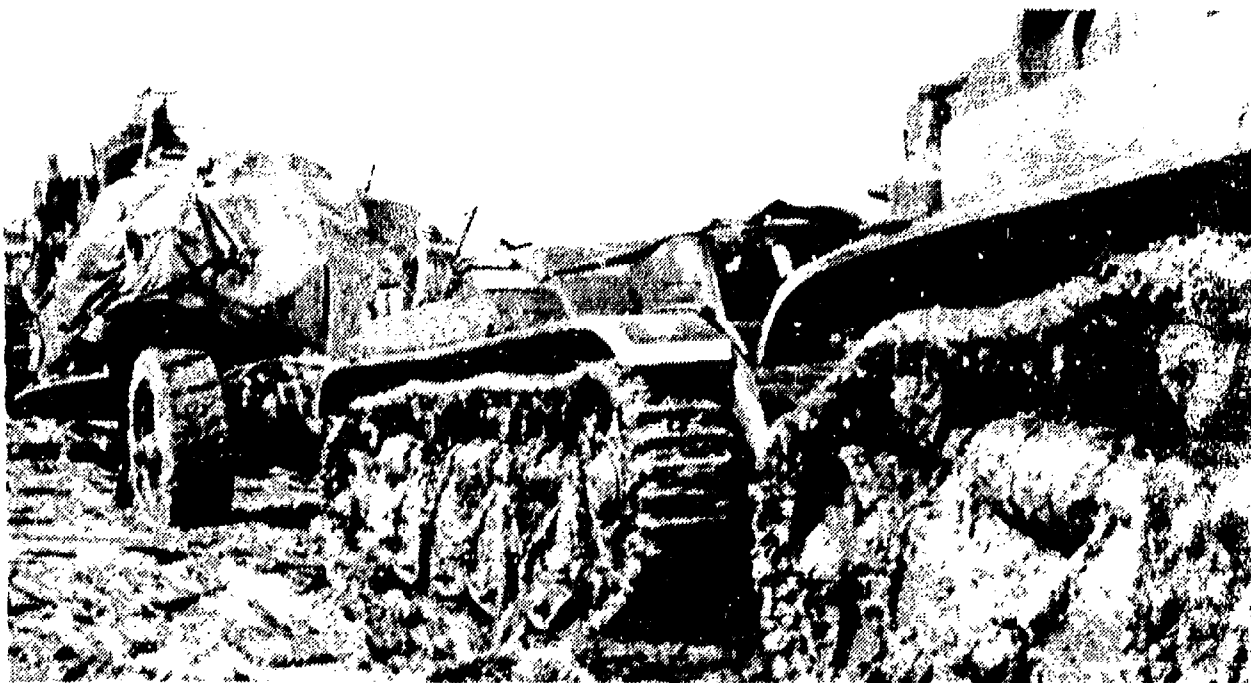
"We had to exploit those factors which still represented a German superiority. Even though, in the larger view, we were not on the defensive, we had to try to deal painful blows to the enemy, causing him considerable casualties, the loss of large numbers of prisoners, and generally predispose him to come to terms. We had to make sure that, even within the framework of a defensive strategy, we should be able to conduct those flexible operations which constituted our main strength."²³

The essential modus operandi was "Tactical defensive, Strategic offensive."

Hitler's influence over operations was in the end the single final determining factor in the German defeat in the East. His constant references to political and economic consideration taking precedence over purely military operations, sealed the fate of the Wehrmacht in the East. Von Manstein's request for "freedom of movement" to implement the elastic methods mentioned above, was not commensurate with Hitler's overall plans. In essence von Manstein's mobile operations were replaced by the Diktat of "not one step backward." Hitler replaced von Manstein on 30 March 1944²⁴ and in his stead appointed Generaloberst (later

²³Carell, P., Scorched Earth, the Russian-German War 1943-1944, Op. Cit., p. 295.

²⁴Von Manstein, Op. Cit., p. 453.



Lack of metalled roads caused the Germans a tremendous loss of mobility during the muddy season.

Photo: Carell, Unternehmen BARBAROSSA



The Wehrmacht had 750,000 horses at the start of BARBAROSSA.
Mobility was often even a problem for draft animals.
Photo: Carell, Unternehmen BARBAROSSA

Generalfeldmarschall) Model, a "firm stander," as Commander of Army Group South (simultaneously renamed Army Group North Ukraine). In parting with von Manstein, Hitler said:

"I have decided to part company with you and to appoint someone else to the Army Group...The time for operating is over. What I need now is men who stand firm."²⁵

As the Wehrmacht assumed its new defensive posture the Schlachtgeschwader became increasingly active. The command was initially integrated in the autumn of 1943 when the position of Waffengeneral der Schlachtflieger* was created. It consisted of 5 Geschwader comprising 14 Gruppen, equipped with JU87Gs, FW190s, and HS129s.²⁶

From the Luftwaffe point of view the formation of the Schlachtgeschwader command was symptomatic of the Luftwaffe's loss as an independent service.

"As for the Luftwaffe its expanding force of anti-tank aircraft showed that it was becoming more and more reduced to the role of a direct auxiliary to the hardpressed eastern armies."²⁷

Late in 1942 the OKW was quite aware of the developing need for a defensive posture. On 6 June 1942 the OKW

*Waffengeneral der Schlachtflieger - Chief of Close-air-support forces.

²⁵Carell, Op. Cit., p. 453.

²⁶Bekker, Op. Cit., p. 438.

²⁷Ibid.

Operations Staff prepared a paper with Generalleutnant Warlimont's signature detailing the numerous deficiencies of the Wehrmacht. Notable extracts are as follows:

Army:

Personnel shortage on the Eastern Front on 1 May 1942 625,000 men; the winter losses cannot be entirely made good.

Armoured divisions in Army Groups Center and North will have only one tank battalion each (approximately 40-50 tanks).

Ammunition difficulties must be reckoned with in August 1942; they may be insufficient to affect operations; replacement from stocks of C in C West.

Mobility is considerably affected by shortage of load-carrying vehicles and horses which cannot be made good. A measure of demotorization is unavoidable.

At present there are no further reserves available in Germany.

Navy:

Situation generally favorable (not entirely agreed to by the C in C Navy).

Luftwaffe:

From 1 May 1941 figures for aircraft servicable have fallen to an average of 50-60% of establishment.

The establishment of anti-aircraft artillery has been raised considerably, but manpower is short.

Recruiting:

The call up of the 1923 class in April 1941 means that we are anticipating by 18 months.

Armament:

During this year oil supply will be one of the weakest points of our economy; it may well influence the operational capabilities of all three Services, the armaments industry and deliveries to our allies (particularly Italy).

Serious shortage of raw material for tanks, aircraft, U-boats, lorries and signal equipment.

Summary:

Our potential is lower than it was in spring 1941. It must be compensated by the infliction of increased losses on the enemy, superior leadership and increased efforts on the part of the troops, quality of weapons and increased emphasis on anti-tank defense. By these means we can ensure superiority at those decisive points where we decide to concentrate.²⁸

The increased emphasis on anti-tank defense naturally included the Schlachtgeschwader. Their first major test came in July 1943 at the ZITADELLE battles, with notable success, as mentioned previously.

General der Flieger a.D. Deichmann has written in the forward of The Luftwaffe War Diaries of an experience shortly following World War II:

"Soon after the war I was commissioned to investigate the history of the German Luftwaffe on behalf of a leading western power. One day, while talking to the high-ranking officer in charge of this investigation, I asked him why a powerful country like his, which after all had won the air war against Germany, showed so much interest in our Luftwaffe. To my surprise he answered, in effect that they wanted to find out how, with its 'handful of weapons and aircraft,' it was able to hold out for so long against the air forces of the world."²⁹

²⁸Warlimont, W., Inside Hitler's Headquarters 1939-45, p. 240, Praeger, 1964.

²⁹Bekker, Op. Cit., p. x-xi.

Considering the Order of Battle in Europe today, the lessons of the Schlachtgeschwader and associated anti-tank units (Panzerstaffeln) in World War II still have considerable applicability.

CHAPTER I

Historical Perspective

Generaloberst Hans Jeschonnek had the dubious distinction of being caught up in the personality and command clashes at the highest levels of the Luftwaffe. Jeschonnek had been appointed Chef des Generalstabes der Luftwaffe (Luftwaffe Chief of Staff) in 1939. He was a relatively junior general at the time and although a brilliant staff officer, his war time thinking had been somewhat clouded by an extreme devotion to Hitler. Reichmarschall Goering*, the Luftwaffe commander, had attempted to use Jeschonnek as a "scapegoat" for all of his (Goering's) failures involving the Luftwaffe, mainly the Stalingrad airlift fiasco. The Generaloberst committed suicide on 18 August 1943.

"Jeschonnek had fallen between two stools--on one side Hitler, who believed in his talent; on the other Goering, whose orders he, as an officer, felt obliged to carry out however contrary to his own

*Goering's reputation began to slip at Dunkirk when he promised to destroy the encircled allies with air power alone--he failed. After that first failure, Goering was forever attempting to regain his prestige with Hitler through the vehicle of the Luftwaffe. This made for the unfortunate case of a major personality in the government having his personal position, prestige, and credibility tied to the operational success of one of the armed services. As such the Luftwaffe was often committed to tasks which it could not fulfill, e.g. Stalingrad.

convictions. He had to endure Hitler's rage for every failure of the Luftwaffe, and Goering's sarcasm into the bargain ('You always stand in front of the Führer like a schoolboy--like a little subaltern with his hands on his trouser seams!'). Jeschonnek was the whipping boy across whose back the two 'old campaigners' vented their spleen. But the back was not broad enough--it broke."¹

The critical post of Goering's Generalstabchef could not be left vacant. The most capable successor in Goering's eyes was Generalfeldmarschall Freiherr Dr. Wolfram von Richthoven.* Von Richthoven was unfortunately not acceptable to Hitler and the position went to Generaloberst Guenther Korten.² Although Korten saw his role as that of Goering's shadow, unlike the energetic Jeschonnek, he (Korten) did institute a number of administrative changes in the Luftwaffe field commands. These changes were instrumental in effecting a clearer division of the tactical and strategic missions of the Luftwaffe. It was one of these changes that instituted the Schlachtgeschwader as an independent arm of the Luftwaffe.³ The position of General der Nahkampfflieger (Inspector of close-air-support units) was created on 5 October 1943.⁴

*Cousin of the famous Manfred of World War I fame.

¹Bekker, Op. Cit., p. 454-65.

²Bekker, Op. Cit., p. 466.

³Smith, P., The Stuka at War, p. 100, Arco Publishing, 1971.

⁴Bateson R., Profile 211, Junkers JU 87D, p. 16, Profile Publications, no date.

The name was changed to General der Schlachtflieger⁵ on 17 October 1943 and the first chief was Oberst Dr. Ernst Kupfer--a most capable officer. The original arm consisted of five Schlachtgeschwader comprising fourteen Gruppen which included JU87s, HS129s, and FW190s, and for a short period, until their removal as unsafe, a few JU88s. The position of General der Schlachtflieger was not a command, the functions were limited to inspection and liaison with other arms, not operations. Individual Schlachtgeschwader came under the command of the appropriate Luftwaffe field unit.

Oberst Kupfer was killed on 6 November 1943 in the crash of an HE 111/H-6 while enroute to Salonika, Greece. His place was taken by Oberst (later Generalmajor) Hubertus Hitschhold who held the position of General der Schlachtflieger until the end of the war.

Within the Schlachtgeschwader the actual anti-tank aircraft were allotted to one Staffel. The only exception was the Fourth Gruppe (consisting of 4 Staffeln) of Schlachtgeschwader Nine, which was equipped solely with HS129s.⁶ The tenth, or special, Panzerstaffel was added one each to Schlachtgeschwader One, Two, Three and Seventy-seven toward

⁵Luftflottenkommando 5, Secret Order Number 11613/43 17 October 1943, (See Appendix IV).

⁶Bateson, Op. Cit., p. 16.

the end of 1943. The Panzerstaffeln were equipped with the JU87G-1 and JU87G-2 aircraft.* The JU87Gs along with the above mentioned Fourth Gruppe of Schlachtgeschwader Nine with the HS129s were the only permanently deployed aircraft specifically designed for the anti-tank mission.⁷ The original strength of the Fourth Gruppe was sixty-eight HS129s.⁸ Each Panzerstaffel had twelve JU87Gs and four JU88s⁹, but the JU88s were withdrawn as unsafe after a brief period of operational flying.¹⁰ (See Figure 2).

The main machine used by the Schlachtflieger for anti-tank operations was the JU87G Stuka. Although the Stuka had numerous deficiencies, it was simple, rugged and easy to maintain in the field. Commenting of the Stuka after the war for the Karlsruhe Project, Generalmajor a.D. Hitschhold said:

*JU87G-1s were modified JU87D-3s; JU87G-2s were modified JU87D-5s; both models carried the Flak 18, 37mm cannon.

⁷Plocher, H., The German Air Force Versus Russia 1943, p. 16-7, Arno, 1967.

⁸Carell, Op. Cit., p. 76.

⁹Plocher, Op. Cit., p. 243.

¹⁰Bekker, Op. Cit., p. 438.

[illegible]

116 Anti-tank Aircraft
out of a total Schlachtgeschwader establishment
of 601 Aircraft.

Source: Karlsruhe Document Collection
K113.3019-4 Frame 1613.

Figure 2

"The JU87 was already at the beginning of the war an out dated aircraft. It was too slow and did not have sufficient defensive capability against enemy fighters."*11

This opinion by General Hitschhold is not shared by other prominent Stuka pilots among them Oberst a.D. Rudel and Brigadegeneral a.D. Hozzel.¹² General Hozzel in particular considered the Stuka to be quite ideal for the Eastern Front, although not suitable for long range operations as in the "Battle of Britain." Regular Stuka units did not even require fighter cover when operating against the Russians. Russian pilots were, by and large, not held in very high esteem by the Luftwaffe.¹³

There was no question on the part of Germany that anti-tank operations were the main concern of the Luftwaffe in and after 1943.¹⁴ In spite of the criticality of the anti-tank mission the Luftwaffe never developed a reliable aircraft that could be used for deep interdiction of enemy tank

*"Die JU87 war schon bei Kriegsbeginn nicht mehr also modernes Flugzeug anzusprechen, war zu langsam und konnte bei operativen Einsätzen nicht genügend Feindjäger geschützt werden."

¹¹Karlsruhe Document Collection, K113.3019-4, Frame 1237, unpublished, 1953.

¹²Interviews; Oberst a.D. Rudel and Brigadegeneral a.D. Hozzel, 1976. (See Appendix X and XI.)

¹³Ibid.

¹⁴Plocher, Op. Cit., p. 242.

forces behind the enemy front lines. Theoretically the JU87G was used only for operations where enemy tanks had broken through the front and penetrated German defensive positions.¹⁵ The HS129 on the other hand, did not have the reliability of the Stuka and had serious maintenance problems, especially with the engines. One of Oberst Kupfer's first actions as General der Schlachtflieger was to demand a conversion of the JU87 units to the faster FW190. Conversion of Schlachtgeschwader units to the FW190 progressed very slowly in 1943 as the mounting volume of Anglo-American massed bombing attacks on the Reich forced the Luftwaffe to retain FW190s as fighters in the Reichverteidung (home defense system).¹⁶ Early in 1944 production of the FW190 increased to the point where conversion of the Schlachtgeschwader from the JU87 to the FW190 was resumed at a rate of 2 Gruppen each six weeks. As a result, only one Gruppe (III/StG 2) of JU87s was still active as a Schlachtgruppe for day operations by the end of 1944.¹⁷ Simultaneously the JU87s were transferred to Nachtschlachtgeschwader (night close-air-support units).

¹⁵Interview, Rudel, Op. Cit.

¹⁶Plocher, Op. Cit., p. 243-44.

¹⁷Green, W., The Warplanes of the Third Reich, p. 218, Doubleday, 1970.

Although FW190s replaced many JU87s in Schlachtgeschwader units, the FW190 did not normally operate in the anti-tank role. The anti-tank mission generally continued to be allocated to the JU87Gs and the HS129s. A FW190F-8/R-3 existed which was equipped with two 30mm MK 103 cannons; however, this model was only a prototype and never reached production status. Some twenty FW190F-3/R-1s with the same MK 103 cannons, were delivered in 1943.¹⁸ Various FW190s with anti-tank rockets were tested, but their operational employment was insignificant.

The HS129 in general had a less effective career as an anti-tank aircraft than the JU87G. Although the HS129 was expressly modified to function as an anti-tank weapons system, problems with the Gnôme Rhône engines precluded operational success on a scale large enough to tip the scales in the German favor on the Eastern Front. The Fourth Gruppe of Schlachtgeschwader Nine did have the notable distinction of destroying a Soviet armoured brigade near Byelgorod, Russia on 8 July 1943. (See Chapter IV). By the war's end the HS129 had faded out of service, its operational employment being reduced to a mere two Staffeln by January 1945.

¹⁸Green, Op. Cit., p. 208.

HS129 models (anti-tank) carried an assortment of cannons: the MK 101 30mm, the MK 103 30 mm, and the PAK 40 75mm cannon. The last of these caused the aircraft to be extremely ponderous and vulnerable,¹⁹ and as such was only used for attacking isolated tanks that had broken through the front. Only two dozen HS129s with the PAK 40 were produced.²⁰

The JU87G Stuka with the twin 37mm Flak 18 cannons was the most reliable and consistent tank-killer possessed by the Luftwaffe. The JU87G, or "Gustav," remained the main anti-tank aircraft of the Luftwaffe up until the end of the war in May 1945. As the Schlachtgeschwader converted to FW190s the JU87Gs were retained as a special anti-tank Staffeln within Schlachtgeschwader One, Two, Three, and Seventy-seven, as previously mentioned. The only pure Stuka unit was the Third Gruppe of Schlachtgeschwader Two.²¹ Oberst Rudel made the JU87G famous and his success with the "Gustav" far exceeded any other Luftwaffe pilot.

¹⁹Ibid., p. 397.

²⁰Green, Op. Cit., p. 396.

²¹Bateson, Op. Cit., p. 17.

CHAPTER II

Training and Operational History of the Schlachtflieger

At the outbreak of World War II the Luftwaffe had accumulated a highly experienced core of elite pilots. This core declined markedly as the war progressed, and the level of experienced personnel in the Luftwaffe continued to decline throughout the war. The basic cause for the lack of properly trained replacement personnel was the Luftwaffe's unpreparedness for a long war.

"There can be no doubt of the fact that the restrictions placed on Branch 3 (training) originated in great part with the man who became Chief of the Luftwaffe General Staff on 1 February 1939. Hans Jeschonnek, the fourth and easily the most significant of the Luftwaffe's General Staff Chiefs, placed very little value on the development of a closely-knit training program. His interests lay in other directions. He was a man of his own day. His responses to the demands of his time were appropriate and sure, and he even showed a certain talent for improvisation when necessary. The establishment of a systematic program of training, by its very nature time-consuming and directed to the future, interested him far less than the employment of already available forces, in other words, of the strategic-tactical force in being. This occupied his interest to the exclusion of almost everything else."¹

¹Suchenwirth, R., Historical Turning Points in the German Air Force War Effort, p. 20, Arno Press, 1966.

Until the latter phases of the war, the Schlachtflieger in general and the Panzerjägerstaffeln in particular continued to receive well trained replacement pilots.² The shortage of fuel had a serious enough effect on combat operations, the fuel shortage was a disaster for Luftwaffe training. Courses were reduced in flying-hour content and increased in length. The increase in length was due to flying hour cutbacks and therefore delays in finishing a course of training.

Under normal conditions a Schlachtflieger would have a rather extensive preparatory training prior to reaching his combat unit. After basic pilot training, the selectee for Schlachtflieger training would undergo a very extensive medical examination to insure that he was physically capable of withstanding the tremendous "G" loads encountered in steep dive recoveries. The Stuka training program was the most commonly used one for Schlachtflieger. The selectee would attend a three month course at a dive bombing school. He would then attend an additional three months of Ergänzung (supplementary) training with advanced tactics, and exercises including training with other friendly aircraft which would simulate enemy tactics. After posting to an operational

²Interview, Brigadegeneral a.D. Hozzel, 1976.

unit the new Schlachtflieger would be a Kettenhund (wingman) for 20 or more combat missions, before being considered for a flight lead position or before being considered operationally ready.

A few pilots were originally co-opted into the Luftwaffe from the Reichswehr in the early and mid thirties and became the elite of the younger Luftwaffe commanders. These specially selected officers were given training in fighters, weather flying, bombers, dive bombers and advanced tactics schools. These former Reichswehr officers became the core of elite within the Luftwaffe and often rose meteorically in the Luftwaffe command structure.³

Towards the end of the war, however, the elaborate training mentioned above was drastically reduced and abbreviated. Pilots often were given only training in the aircraft that they would fly in combat. The early battles in Russia in 1941 cost the Luftwaffe dearly in terms of losses of experienced personnel. The failure to develop a program for adequately trained replacement pilots, prior to and early in the war, was a major cause for the deterioration of the quality of Luftwaffe personnel as the war progressed.

³Ibid.

A noteworthy feature of the training and subsequent employment of the Schlachtfliegern was the close identification with the German soldier on the ground, whom they supported from the air. One manifestation of this bond of comradeship was the "Infantry Assault Badge" that was painted prominently on the noses of Schlachtflieger aircraft.

The normal complement of a Luftwaffe Schlachtfliegergruppe appeared thusly:⁴

- 1 Commander (a Major or Oberstleutnant, or in rare cases an exceptionally well qualified Hauptmann)
- 20 Officer pilots
- 30 Enlisted pilots
- 50 Bordfunker/Bordschützer (backseaters of the Stukas, not applicable to the HS129s)

Schlachtflieger units were normally echeloned in the following manner:⁵

Unit	Aircraft + Res. = Total			Commanded by a (or Exceptional):
=====				
<u>Staffel</u>	12	+ 3	= 15	<u>Hauptmann</u> (<u>Oberleutnant</u>)
<u>Gruppe</u>	3	<u>Staffeln</u> + <u>Stab</u> (5)=50		<u>Oberstleutnant</u> or <u>Major</u> (<u>Hauptmann</u>)
<u>Geschwader</u>	3	<u>Gruppen</u> + <u>Stab</u> (3)=153		<u>Oberst</u> or <u>Oberst-</u> <u>leutnant</u> (Major)

⁴Ibid.

⁵Ibid.

The actual training of the JU87G anti-tank units appears to have been conducted on a piecemeal basis at the front. Oberst Rudel for example, mentions introducing the new JU87G cannon-carrying Stuka to his unit.⁶ The HS129 pilots were, however, trained by the 11th (Pz) Staffel of Schlachtgeschwader Nine, which was relocated from the Eastern Front on 27 December 1943 and reformed as a training unit in Germany.⁷

Operational History of Anti-Tank Aircraft⁸

By 1942 the Soviets had made up the tank losses of the previous year through great increases in tank production and deliveries from their allies. Smaller tank formations or tank supported infantry continually sought to breach the over-extended German front. Soviet tank attacks led to crisis situations as the Wehrmacht rarely possessed sufficient anti-tank weaponry on the Eastern Front. The employment of Stukas and close-air-support aircraft with bombs against single-tank targets proved ineffective. The Luftwaffe leadership therefore sought to rectify the situation by arming aircraft with anti-tank cannons.

⁶Rudel, H., Stuka Pilot, p. 76, Washburn, 1953.

⁷Mahlke, H., Nahkampfflieger Verbände, p. 60, Schweiger & Pick Verlag, 1971.

⁸Ibid., p. 57-59.

The first confrontation of cannon armed aircraft and Soviet armour came in June 1942 with the HS129 carrying a MK 101 Bordkanonen. The destruction of 23 Soviet tanks in the course of the battle of Kharkov in mid-June 1942 demonstrated the effectiveness of the new weapons system. By December the four Gruppen of Schlachtgeschwader One and Two each possessed a Panzerjägerstaffel of HS129s as a special formation for enemy tank destruction from the air. Additionally it was directed at the end of 1942 that each Jagdgeschwader (fighter wing) would have a HS129 Panzerjägerstaffel assigned to it, however, only one was so outfitted; the Tenth (Pz) Staffel of Jagdgeschwader 51. By the end of 1943 this unit (10 (Pz)/JStG 51) was assigned to the southern sector of the German Eastern Front.

A test command for the employment of anti-tank aircraft was established by the Luftwaffe at the Rechlin test center late in 1942. In April 1943, this unit was transferred to the Eastern Front. The unit consisted of JU87Gs with 37mm cannon mounted under each wing, JU88s with one centerline mounted 75mm cannon, MD110s, and HS129s. The JU88s and ME110s were not certified for combat due to technical and aerodynamic difficulties. The remaining HS129s and JU87Gs were assigned to support the army on the Kuban bridgehead. They did so with excellent results, sinking over 100 Russian

troop transport craft in the lagoon. Hereafter the employment of Panzerjägerstaffeln was restricted to hunting and destruction of enemy tanks. Tactics were developed to solve the problems associated with attacking the enemy armoured formations immediately in front of friendly ground troops.

On 17 June 1943, the test unit was disbanded. The aircraft were assigned to individual Geschwader as Panzerjägerstaffeln. In February 1943, at Chortiza Panzerjagdkommando Weiss was formed; this unit enjoyed numerous successes in combating tanks which had broken through the German front lines. From this unit the command of Führer der Panzerjägerstaffeln was created, and the previously individual Staffeln were brought together into a single unit where they could be concentrated at critical points all along the Eastern Front.

Thus the Panzerjägerstaffeln came into numerous successful operations in the critical phases of the German defensive and counter attacking battles of 1943. During the ZITADELLE battles the Panzerjägerstaffeln were instrumental in protecting the exposed flank of the Second SS Panzer Corps and in keeping the Orel-Karatschew logistics line open.

With the general reorganization of the Schlachtgeschwadern in November 1943, the HS129s were all combined into the Fourth (Panzer) Gruppe of Schlachtgeschwader Nine. The

remaining JU87Gs were retained as special units within the individual Schlachtgeschwader until war's end.

In the heavy defensive battles of the last year of the war, the Panzerjägerstaffeln were coupled with other Schlachtflieger and employed in the critical areas up to the very end of the war. The Panzerjägerstaffeln attempted to counter the overpowering strength of the Soviet tank formations; and attempted to extract the highest possible price from the advancing Russians. The Panzerjägerstaffeln were often instrumental in allowing German ground forces to escape capture by Soviet units and withdraw in good order to the West. On 8 May 1945 the Geschwaderkommodore of Geschwader Immelmann flew the last Panzerjägerstaffel sortie of the war. He alone had destroyed 519 Soviet tanks from the air.

CHAPTER III

Setting, Tactics and Historical Summary

To place the 1943-44 Russo/German military setting, in its strategic context, a brief review of Russian military geography in the eyes of the Luftwaffe is in order. To a German, the most ominous and yet alluring characteristic of Russia, was its seemingly unlimited size (1941: 8.35(10)⁶ square miles). The Lebensraum policy would have been meaningless without the vast, relatively under-populated areas of the western Soviet Union. Indeed, General a.D. Professor Karl Haushofer's idea of boundaries was that of "a biological battlefield in the life of peoples."¹ Haushofer and his theories of Lebensraum and Geopolitik were similar to those of Hitler, and through Rudolph Hess, one of General Haushofer's more prominent students, there is probably a more direct connection between Hitler's theories and those of the scholar general.

The Kolan Peninsula (highest elevation 4068 feet), Yayla Mountains in the Crimea (highest elevation 5059 feet), the Caucasus (Mount Elbrus 18,472 feet), and the Urals (highest

¹De Blij, H.J., Systematic Political Geography, p. 171 Wiley & Sons, 1973.

elevation 5512 feet) are all exceptions to the usually low character of the European Russian landmass. Flat and expansive heights, or more hilly terrain, rise about 650 feet above the extensive lowlands. The hilly areas comprise the northwestern Karelian and Kolan Peninsulas. To the east and south of those areas are the Valdai Hills (highest elevation 1056 feet) and Timanskiy Roge (highest elevation 850 feet). The above mentioned areas are the major contrast to the vast bleak, and monotonous Russian landscape. This landmass is divided by some of the largest rivers in the world: the Volga, Dnieper, Don, Kama and Severnaya-Dvina are well over one thousand miles in length. The relatively higher elevations of the western banks of Russian rivers, in contrast to their relatively lower eastern banks, tend to favor forces attacking from west-to-east. The Pripyat river, an exception to the general north-to-south or south-to-north flow, runs from west-to-east. The Pripyat, with its source around the Mazurian Lakes in East Prussia, creates an almost insurmountable obstacle to movement in any direction. That river forms the Pripyat Marshes due to its subdivision into a densely branching system of tributaries. The largely impassable Pripyat Marshes accounted for the huge gap between the combat zones of German Army Group Center and Army Group South.

The forest zone south of the tundra line afforded excellent concealment and potential cover for the defending Russians. Forest, coupled with large area, broad river systems, and primitive communications all worked to the advantage of the defenders. The formidable geographic features were not comparable, however, with the advantage offered the Russians in the form of potentially severe winter weather. The Germans had the misfortune of attacking in 1941 which proved to include the worst winter in Europe in two and one-half centuries.² Forty degrees of frost were recorded in the winter of 1941-42, as early as the end of November and the first days of December. In frustration, the Luftwaffe units in Russia were forced to use open fire heaters for warming aircraft engines and coined the expression "start up or burn up."³ The Luftwaffe commander of two Stukagruppen (with a normal establishment of 100 aircraft) at the battle for Moscow in 1941, could only put three to six aircraft in the air each day due to combat losses and maintenance problems associated with the unprecedented cold weather.⁴

²Stolfi, R.H.S., Chance in History, The Russian Winter, of 1941-42, p. 21.

³Interview, Oberst a.D. Rudel, 1976.

⁴Interview, Brigadegeneral a.D. Hozzel, 1976.

BARBAROSSA had sought a favorable military solution in Russia within six to twelve weeks, yet Germany found itself in 1943 in the third year of a war with the Soviet Union. Operation TYPHOON (code name for the operation to capture Moscow in 1941) had not been successfully concluded, by early 1943, the 230,000 men of the Sixth Army were either dead or in Russian captivity after failing to hold Stalingrad,⁵ North Africa had been lost, the summer offensive into the Caucasus had to be recalled, and ZITADELLE was prematurely called off as Hitler withdrew the Second SS Panzer Corps to strengthen Italian forces as a counter to allied landings in Sicily. By late 1943 the Wehrmacht was faced with a collection of enemies growing stronger with each passing day, while Germany could only count on becoming relatively weaker. The urbane von Manstein was requesting "freedom of movement" at Army Group Don and Hitler was searching for "firm standers." The prospects in 1943, after the failings mentioned above, were none too optimistic for the Wehrmacht. It was into this setting that the newly formed Luftwaffe anti-tank units were thrown in the massive German defensive battles, all along the Eastern Front.

⁵Carell, P., Unternehmen Barbarossa, Der Marsch nach Russland, p. 549, Ullstein, 1963.

The anti-tank aircraft were, in effect, extraordinarily mobile flying anti-tank artillery. By 1943, due to the grossly disproportionate lower number of German formations facing the Russian masses, the Wehrmacht could no longer successfully cover the entire front. The poor road net, shortage of petrol, and general lack of resources, forced the Wehrmacht into the use of cannon carrying aircraft as anti-tank weapons systems. Aircraft possessed the mobility and speed necessary to concentrate firepower over distances of strategic significance in the broad expanses of the Ukraine in order to counter the powerful Soviet armoured thrusts at the German defensive positions. A Stuka anti-tank formation, for example, could easily counter an armoured break-through 150 miles from the Stuka home base and put ordnance on target in less than an hour from initial notification. The Wehrmacht had spent itself in the previously mentioned offensive battles and after ZITADELLE (July 1943), the Germans were never again to regain the initiative on the Eastern Front. The Wehrmacht had been inexorably bled white by Hitler's strategic miscalculations*, no longer possessed the resources for major

*Perhaps this criticism of Hitler is a bit harsh. It has been said by Generalfeldmarschall Rommel, amongst others, that Hitler knew he could no longer win the war after the defeats at Stalingrad and in North Africa. Hitler was, however, rebuffed in his attempt at negotiations with the West

offensive operations, and required imaginative innovations in anti-tank defense like flying high-velocity, automatic cannons.

The Wehrmacht ground situation dictated the methods employed by the anti-tank Staffeln. The Staffeln became an extremely effective weapon system available to the badly outnumbered German ground forces, enabling the Germans to concentrate anti-tank weaponry rapidly against attacking Soviet armoured formations. The time required to move a German division into position from Army Group Don to Army Group Center to counter an attacking Soviet armoured formation was often too long and therefore precluded the use of ground forces. Aircraft, on the other hand, could quickly bring massed anti-tank firepower to the scene--often in minutes. Four JU87G Stukas could carry eight 37mm anti-tank

as his regime was not politically acceptable.⁶ In effect, Hitler had two options: handing the hard won reins of power over to a military junta, which could negotiate with the western leadership, or remaining at the helm and following the "strategy of a flamboyant downfall"⁷, until the Third Reich was literally beaten to death. Hitler opted for a "Wagnerian termination," finis coronat opus.

⁶Liddell Hart, B.H., The Rommel Papers, p. 428, Harcourt, Brace & World, 1953.

⁷Fest, J.C., Hitler, p. 693, Harcourt Brace Jovanovich, Inc., 1973.

cannons and 48 rounds of ammunition, each capable of knocking out a Soviet tank by perforating the top, rear side or, rear armour.

The Luftwaffe used four basic cannon designs to equip its anti-tank aircraft: the Flak 18, MK 101, MK 103, and PAK 40* whose characteristics are as follows:

<u>Cannon</u>	<u>Calibre</u>	<u>Aircraft Platform</u>	<u>Number of Rounds</u>
Flak 18	37mm	JU87G	12 (6 per gun)
PAK 40	75mm	HS129	12
MK 101	30mm	HS129	30
MK 103	30mm	HS129	30

The Flak 18 was fitted to the JU87G Stuka in the form of two pod-mounted cannons, one 420 kilogram cannon being attached under each wing outboard of the main landing gear.⁸ Each cannon carried six rounds of 37mm ammunition and the muzzle velocity was 2159 feet per second.⁹⁺ (See Appendix III for complete penetration capabilities).

*PAK - Panzerabwehrkanonen - anti-tank cannon.

⁸Just, G., Stuka-Oberst Hans Ulrich Rudel, p. 132, Motor Buch Verlag, 1975.

⁹Smith, P., Stuka at War, p. 90, Arco Publishing Company, 1971.

+Oberst Rudel's were special 37mm rounds and had a muzzle velocity of 1100 meters per second.

The MK 101 and MK 103 cannons were basically similar except that the MK 103 had a higher muzzle velocity and flatter trajectory. Both MK 101 and MK 103 armament packs carried 30 rounds of 30mm ammunition. The 30mm packs were carried on the HS129 centerline armament station.

the PAK 40 75mm cannon had very little combat service when mounted on the HS129 aircraft because so few were produced for use with that airplane. The PAK 40 equipped HS129s were also so ponderous and vulnerable as to make them suitable only for employment against isolated tanks that had broken through the front lines.

There were several munitions, aside from cannon, that were used by the Luftwaffe against armoured vehicles. Initially in the war, the Luftwaffe used large high-explosive bombs (500 kilogram) and a type of napalm (Flammbomb). These weapons were not overly successful against tanks; almost a direct hit was required to neutralize an armoured vehicle. Experience showed chances of a hit and subsequent kill were greatly improved with a large number of smaller bomblettes (4 kilogram) dropped from one container. This cluster system was designated as SD-4-H1*, and the hollow charge principle enabled the bomblettes to penetrate armour up to a thickness

*Abbreviation for Hohlladung - Hollow charge.



A clip of six 37mm cannon shells.



A close-up of the wing mounted 37mm cannon.
(Wheel covers are removed from this Stuka to
facilitate operations on muddy fields.)



Servicing the MK 101 30mm cannon on the HS129 aircraft.



Servicing the MK 101 30mm cannon on the HS129 aircraft.

of 128mm.¹⁰ The optimum effectiveness of the SD-4-H1's was found to be when carried in a 500 kilogram container carrying 78 SD-4-H1s. These munitions were carried primarily by the JU87 Stuka. During 1944, the use of bomblettes decreased as the JU87s were replaced by FW190s which were not designed to drop the SD-4-H1s. The anti-tank rockets developed in late 1944 and early 1945, did not reach the Luftwaffe units in the field in sufficient quantity or time to have any decisive effect on the outcome of the war.¹¹

The specific tactics used in delivering bombs against armoured targets normally began with an attack from an altitude of approximately one thousand meters and dive angle of thirty to forty-five degrees. Ordnance was released on the basis of the pilot's sight picture.¹² It was necessary to hit the tank or come very close (within twelve feet) in order to neutralize it.¹³ Anti-tank bomb and napalm attacks were different from normal Stuka dive attack. A normal attack would commence at approximately 4000 meters, then establish a dive angle of 80 to 90 degrees, set air-speed

¹⁰Deichmann, P., German Air Force Operations in Support of the Army, p. 48, Arno, 1962.

¹¹Ibid.

¹²Interview, Hozzel, Op. Cit.

¹³Deichmann, Op. Cit., p. 49.

of 560 KPH (with speed brakes extended) and then release at an altitude of between 500 and 700 meters. In extremely high threat areas the speed brakes would not be used and the Stuka would pull out at a velocity of 700 KPH.

Attacks against tanks using the airborne cannon were very individual according to the technique and skill of each pilot. Rudel, for example, would roll in from approximately eight hundred meters and attain an attack speed of 320 to 340 KPH (200 to 212 MPH). He would then make rapid and random evasive maneuvers (jinking) in a roughly twenty degree dive angle. The Stuka's internally mounted 7.62 MG would sometimes be used for tracking prior to firing one round from each of the wing mounted 37mm cannons. Rudel would only stop his jinking long enough to aim and fire. It is important to note that Rudel, at the war's end, had over 2500 combat sorties and the experiences that he had gained enabled him to "see" slant ranges and thereby fire at the appropriate moment and then immediately commence jinking again to avoid the Soviet Flak batteries.¹⁴ Both JU87G and HS129 pilots preferred to work at minimal slant ranges in order to improve accuracy and this type of close-in tactic naturally called for very aggressive and skilled

¹⁴Interview, Rudel, Op. Cit.

pilots. Aircraft losses during the phase of flight when the pilot was acquiring his target, prior to firing were quite high.¹⁵ Naturally a pilot with Rudel's experience had an advantage in that he was able to judge slant range almost by instinct and therefore could jink for a longer period of time prior to firing, and more importantly he did not require a long time flying in the same flight path while tracking a target prior to firing.

Later in the war after the Soviets had experience with the tank-killers, Flak was increased and the attacking anti-tank aircraft went to a system of FW190s or normal Stukas flying Flak suppression while the JU87Gs attacked the tanks. This system proved very effective, especially in Rudel's case.¹⁶

It is unavoidable that so much attention is given to Germany's top tank-killer, Oberst Rudel. His personal exploits and association with the Luftwaffe anti-tank mission are so impressive as to overshadow any other individual. The author is cognizant of the fact that Rudel was a most unusual man and certainly not the norm, then or now. However, his characteristics can be a most valuable guide to

¹⁵ Ibid.

¹⁶ Rudel, H., Stuka Pilot, p. 77-78, Washburn, 1953.

the desired ideal. The German hierarchy was also aware of this fact. In a conversation between Oberst Kupfer, the General der Schlachtflieger, and Generalfeldmarschall Milch, the Reichsminister der Luftfahrt (State Secretary for Aviation) late in 1943, Milch stressed the point that it would be nice to have more men like Rudel to stick in Luftwaffe cockpits.¹⁷ In this same conversation a rather sophisticated appreciation of Waffenstolz* appears. There was concern that mixed Geschwader with Staffeln of FW190s and JU87s might jeopardize the Waffenstolz and therefore effectiveness of the units involved. Milch drew the analogy of a regiment composed of battalions of Grenadiers and Fusiliers to that of a Geschwader composed of Schlacht, Stuka and Panzerjäger Gruppen. The anti-tank Staffeln were independent units, self-sustaining and did not come under the operational control of Gruppen. Milch was also responsible for changing the name from Nahkampfflieger to Schlachtflieger, as it was thought that Nahkampf had somewhat of an inferior ring to it. Schlacht, on the other hand, was more aggressive and emphatic in tone.

*Waffenstolz, a difficult term to translate, essentially a soldier's pride in his weapons system, but also carrying the implication of aggressive utilization when such pride is evident.

¹⁷Karsruhe Document Collection, K113.3019-4, frame 0083, unpublished, 1953.

The disposition of ground forces on the Eastern Front
after ZITADELLE appeared as follows:¹⁸

Germans

Russians

		(Leningrad Front/5 Armies
Army Group North	((Volkhov Front/5 Armies
2 Armies	((North-west Front/2 Armies
		(Kalinin Front/4 Armies
	((Western Front/5 Armies
Army Group Center	((Bryansk Front/8 Armies
5 Armies	((Central Front/6 Armies
		(Voronezh Front/9 Armies
	((Steppe Front/4 Armies
Army Group South	((South-West Front/4 Armies
4 Armies	((Southern Front/5 Armies
Army Group "A"	((North Caucasus Front/4 Armies
1 Army	(

¹⁸Carell, P., Scorched Earth, the Russian-German War 1943-1944, p. 293, Little, Brown, 1970.

CHAPTER IV

"Airpower at Kursk"

The projected deployment of A-10 close-air-support aircraft to Europe to augment NATO's air forces, has the potential of significantly redressing the massive Warsaw Pact advantage in armour which presently exists in Europe. Currently NATO possesses 6100¹ tanks compared with the Warsaw Pact's 27,000² (including the 3 Western Military Regions of the USSR). The A-10 with its 30mm GAU 8 cannon has comonstrated a consistently superior tank killing capability.³ With reference to the disparity in the figures above, the need for NATO to develop an aggressive and mobile anti-tank force is obvious.

Many historical precedents for modern warfare were established on the Eastern Front in World War II, as the German and Russian armies fought one another for nearly 4 years. One of these precedents was the confrontation of

¹White Paper 1975/1976, The Security of the Federal Republic and Development of the Federal Armed Forces, p. 33, Federal Ministry of Defense, 1976.

²Ibid.

³Aviation Week and Space Technology, p. 15, 5 January 1976.

aircraft versus tank, during the ZITADELLE (Citadel) battles of July 1943. ZITADELLE was the code name given to the last great German offensive which was aimed at the Russian salient around the city of Kursk. It was during this battle that tactical aircraft scored the first significant victory over enemy ground armoured forces, without any assistance or contact with friendly ground troops. This encounter proved the utility of anti-tank aircraft.

German army commanders were not in the habit of heaping praise on their counterparts in the Luftwaffe. On the occasions when such praise was forthcoming one can rest assured that it was well deserved. A case in point is the teleprint sent by Generaloberst (later Generalfeldmarschall) Model to the First Fliegerdivision:

"For the first time in the history of the war the Luftwaffe has contained the danger of strong armoured formations threatening the rear of two German armies, without any assistance from friendly ground forces."*⁴

This historical achievement was during the final phases of Operation ZITADELLE when the German units were withdrawing.

*"Erstmalig in der Geschichte des Krieges ist es der Luftwaffe gelungen, eine rückwärtige Bedrohung von zwei Armeen durch eine stärkere russische Panzerheit ohne jedes Mitwirken von Erdkräften zu beseitigen."

⁴Karlsruhe Document Collection, K113.3019-4, frame 1635, unpublished, 1953.

Generaloberst Model was referring to the sealing off of a Russian break-through on 19 July 1943 which had blocked the Bryansk Orel railway at Khotinez-- thus imperiling the only reinforcement route for two German armies. On the same day practically every battle-worthy Gruppe of the eastern Luftwaffe was packed into the First Fliegerdivision area based at Karachev, Russia, to counter the Russian break-through. As a result it was possible to seal off the area and shortly afterwards clear the Orel salient of Russian troops. "By its vital contribution at Karachev, from 19-23 July 1943, the Luftwaffe had in fact prevented a second Stalingrad on an even more terrible scale."⁵ "Prevented a second Stalingrad," this indeed was the only consolation for the Luftwaffe and Wehrmacht as ZITADELLE had failed in its critical objectives and Generaloberst Model was retreating. The Luftwaffe played a significant part in the entire ZITADELLE operation, and a more comprehensive examination of the actual planning and conduct of operations is necessary to comprehend fully the Luftwaffe's role in the last great German offensive on the Eastern Front.

The specific contribution of the anti-tank aircraft in ZITADELLE came on 8 July 1943 (fifth day of the German

⁵Bekker, C., The Luftwaffe War Diaries, p. 439-40, Ballantine, 1969.

offensive) culminating in the destruction of a Soviet armoured brigade near Byelgorod, Russia, by the Fourth Panzergruppe of Schlachtgeschwader Nine. After an overview of the entire ZITADELLE battle, an analysis of the Fourth Panzergruppe's action at Bylgorod will be presented.

In anticipation--or perhaps only wishful thinking--Hitler said "The victory of Kursk must have the effect of a beacon on the world."⁶* Hitler was overly optimistic about the prospects, but considering the magnitude of recent Wehrmacht successes over the Russians and the return of the initiative to the German armies, the situation of the Eastern Front did offer the chance to inflict a serious strategic reverse on the Russians. The opportunity was squandered at Kursk. The formidable striking power of some of the proudest and most battle-tested German combat formations was lost along with the initiative on the Eastern Front.

The actual developments leading up to ZITADELLE began with Generalfeldmarschall von Manstein's masterly counter stroke at Kharkov, Russia, in March 1943, which climaxed his winter campaign of 1942-43. Von Manstein, as commander

*"Der Sieg von Kursk muss für die Welt wie ein Faral wirken."

⁶Philippi, A., and Heim, F., Der Feldzug Gegen Sowjet-russland, 1094-1945, p. 211, W. Kohlhammer, 1962.

of Army Group Don, broke down the four phases of his winter campaign as follows:

"The first was the struggle for the relief of the Sixth Army, on which Army Group staked everything it could possibly afford.

The second phase was the Army Group's struggle to keep the rear of Army Group "A" free while it was being disengaged from the Caucasus front.

The third phase consisted of the actual battle to keep open the lines of communications of the German armies' Southern wing and to prevent it from being tied off.

This led to the final, fourth phase, in which the Army Group succeeded--if on a smaller scale than it would have liked--in delivering the counterblow culminating in the Battle of Kharkov."

The first phase of relieving Generaloberst (later Generalfeldmarschall) Paulus's Sixth Army at Stalingrad was abandoned after all hope of linking up Generaloberst Hoth's Fourth Panzer Army vanished. To avoid a disaster of greater magnitude than Stalingrad, von Manstein had to cover the rear of Generalfeldmarschall von Kleist's Army Group "A" during its withdrawal from the Caucasus. This second phase of von Manstein's 1942-43 winter campaign has not been given the credit it is due. Had the Russians succeeded in cutting off Army Group "A," the war on the Eastern Front would have been shortened considerably. The final (fourth) phase of von Manstein's campaign can be described only as the work

⁷Von Manstein, E., Lost Victories, p. 375, Henry Regnery, 1958.

of a most gifted soldier and strategist. Commenting on von Manstein's winter campaign, the English military historian Liddell Hart wrote:

"Following Paulus's surrender, a widespread collapse developed on the Germans' southern front under pressure of advancing Russian armies, but Manstein saved the situation by a brilliant flank counterstroke which recaptured Kharkov and rolled back the Russians in confusion. That counterstroke was the most brilliant operational performance of Manstein's career, and one of the most masterly in the whole course of military history. His detailed account of the operation is likely to be studied, for its instructional value, so long as military studies continue."⁸

Kharkov fell to the Second SS Panzer Corps, subordinated to von Manstein's Army Group Don on 14 March 1943. The initiative on the Eastern Front then passed back into German hands. Von Kluge (commander of Army Group Center) and von Manstein opted for starting ZITADELLE with an attack early in May. Hitler, however, decided against the advice of his two Army Group Commanders, who were ultimately responsible for the operation. Hitler wanted to wait for deliveries to the front of new tanks (Tigers and Panthers)* and other equipment prior to commencing hostilities. Von Manstein

*The Panther weighing about 40 tons, armed with a 75mm gun, appeared in 1942. The Tiger was in the 60-ton weight class and was armed with the very excellent long-barrelled 88mm anti-tank gun.

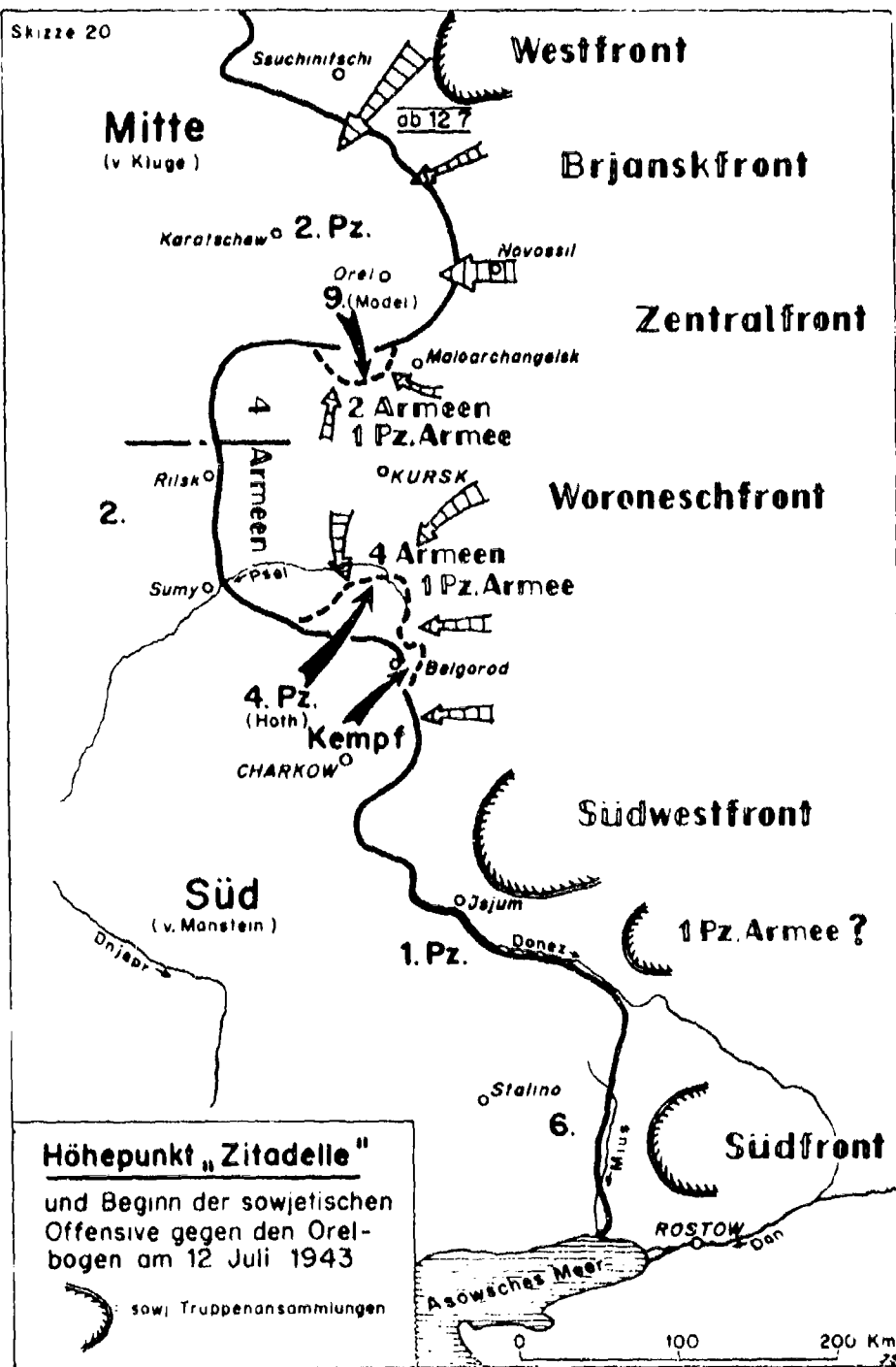
⁸Ibid., p. 15.

and von Kluge were not voting. ZITADELLE was delayed until July 1943.

The basic idea in ZITADELLE was to strike the Russians a blow of limited scope before they had time to recover from losses in the winter campaign. A suitable target presented itself at the Soviet salient which protruded into the German lines around the city of Kursk (see map page 76). For this operation all available armour was to be concentrated in two great pincers. "The objective of the attack was to encircle the enemy forces in the Kursk area by means of a well coordinated and rapid thrust of two attacking armies from the areas of Bylgorod and south of Orel and to annihilate them with concentric attack."⁹ Generaloberst Model with his Ninth Army was to attack from the north and Generaloberst Hoth with the Fourth Panzer Army was to attack from the south. The initial assault delegated eight Panzer divisions to Hoth and five to Model.¹⁰ Several infantry divisions were to join the attack and therefore neighboring fronts had to be thinned out in order to provide sufficient forces for the offensive. Lagging equipment deliveries, conflicting

⁹Carell, P., Scorched Earth, the Russian-German War 1943-1944, p. 22, Little, Brown, 1970.

¹⁰Von Mellenthin, F.W., Panzer Battles, p. 215, University of Oklahoma Press, 1956.



opinions at headquarters, and Hitler's vacillations postponed the offensive until 4 July 1943. The final disposition of forces allotted to Hoth in the south consisted of ten Panzer divisions, one Panzergrenadier division and seven infantry divisions. The northern thrust delivered by Model consisted of seven Panzer, two Panzergrenadier, and nine infantry divisions.¹¹ Von Kluge, von Manstein and Guderian (Inspector of armoured forces) all urged Hitler at this time (early July) to abandon the offensive as it was obvious the Russians were aware of German preparations* and the attack would not in their professional military opinion succeed.

"Befehl ist Befehl."[†] After Hitler's decision, the two army group commanders proceeded with all possible energy in an attempt to make ZITADELLE a success. In the lull following the third battle of Kharkov, German units were withdrawn from

*In his book Scorched Earth, Paul Carell states that the German plan ZITADELLE was known in detail to the Soviets through their agent "Werther" who worked at OKW. Carell makes a strong case. There appears to be little doubt that top secret operational OKW orders reached the USSR via an operative in the pay of the Swiss General Staff. Considering the unusually well prepared defensive positions around Kursk, it is safe to assume the Russians were well informed on German intentions.

[†]"An order is an order."

¹¹Ibid., p. 216.

the front and given extensive training the the latest tactics. Combat formations were outfitted to full strength-- a luxury seldom experienced by the Germans on the Eastern Front in 1943. No single previous battle on the Eastern Front had had such a concentration of German men and equipment. The combined striking force had a total of 3000 tanks and self-propelled guns in addition to 1800 tactical aircraft.¹²

The elite of the Waffen SS* units were poised for the offensive. General der Waffen SS Paul Hausser's Second SS Panzer Corps included three Panzer divisions: the Liebstandart Adolph Hitler (hereafter referred to as L.A.H.), Totenkopf, (Death's Head), and das Reich. The Forty-eighth Panzer Corps commanded by General der Panzergruppe von Knobelsdorff, included the Third and Eleventh Panzer Divisions plus the Gross Deutschland Panzergrenadier Division. The Gross Deutschland was a very strong division with a special organization. It contained 80 tanks in a Panther detachment,⁺ one Panzer regiment, two motorized infantry regiments--one a grenadier

*Waffen SS - Weapons SS - combat formations of the SS serving under Wehrmacht command, not to be confused with the regular SS non-combat units.

⁺The Gross Deutschland possessed a total of 180 tanks for the ZITADELLE battles.

¹²Carell, Op. Cit., p. 24.

regiment*-- and one a rifle regiment.¹³ These two strongly augmented corps made up the main striking forces of General-oberst Hoth's Fourth Panzer Army.

In the north, Generaloberst Model commanded the Ninth and Second Armies in a personal union,¹⁴ although the actual striking force for the offensive consisted only of the Ninth Army. Model enjoyed a rare position as a senior Wehrmacht general of being well thought of, and more importantly, trusted by Hitler. It was primarily Model who had persuaded Hitler to postpone the offensive until July. The General's aerial photos detailing the Russian defensive positions¹⁵ convinced the Führer that it was necessary to have as many of the new Panther and Tiger tanks for ZITADELLE as possible, thus injecting a fresh tactical approach to the Eastern Front. The Panthers--as with most new weapons's systems--still had many "teething pains." "The track suspension and drive were not right and the optics were also

*There was little difference in the establishment of these units. The Panzergrenadiers had a somewhat higher proportion of heavy weapons.

¹³Von Mellenthin, Op. Cit., p. 218.

¹⁴Von Tippelskirch, Geschichte des Zweiten Weltkrieges, p. 331, Athenäum, 1959.

¹⁵Guderian, H., Panzer Leader, p. 306, Dutton, 1952.

not satisfactory."¹⁶ In spite of Generaloberst Guderian's protests the Panthers were sent to the front for use in ZITADELLE. According to Guderian, it was the new Chef der OKH, Generaloberst Zeitzler who persuaded Hitler to continue with the Kursk offensive.¹⁷

The actual conduct of operations by the Germans was tactically successful considering the Russians lost four times what the Germans did in terms of casualties.¹⁸ However, the Russians could afford the losses, the Germans could not. ZITADELLE marked the end for any possible German victory on the Eastern Front.

In the north Model's forces quickly became bogged down in the extensive Russian defensive positions, advancing only nine miles in two days.¹⁹ After regrouping, a second attack deepened the penetration a few more miles, however, the start of the Russian counter stroke at the German Orel salient to the north and northeast on 11 July 1943, precluded any further German advance from the northern wing of ZITADELLE. In order to support his Second Panzer Army to the north, Model

¹⁶Ibid., p. 310.

¹⁷Ibid., p. 311.

¹⁸Von Manstein, Op. Cit., p. 449.

¹⁹Ibid., p. 448.

was forced to divert forces from the ZITADELLE operation, thus bringing all German offensive action on the northern pincer to a premature end.

Operations at the German southern pincer developed more favorably. By 11 July the armoured forces had broken through the last defensive positions and into the area of Prokhorovka and Oboyon.²⁰ Oberstleutnant Kark Ullrich with the Third Battalion, Sixth SS Panzergrenadier Regiment of Division Totenkopf, personally led his men forward and late on the evening of 10 July stormed the village of Krasnyy Oktybr and formed a bridgehead across the river Psel. Simultaneously on the right of Totenkopf, Divisions L.A.H. and das Reich advanced toward Prokhorovka (see map page 76). To the south of Hoth's Fourth Panzer Army, General der Panzertruppe Kempf with Army Detachment Kempf* was to intercept Soviet forces attempting to relieve the hard-pressed Russians engaged by Hoth. The situation rapidly developed around the village of Prokhorovka where a decision was forced.

On the Soviet side, the commander of the Soviet Fifth Guards Army, Lieutenant General (later Marshall) Rotmistrov

*It was common practice in the Wehrmacht for special formations to be designated by the commander's name, e.g. Army Detachment Kempf.

²⁰Von Manstein, Op. Cit., p. 448.

was Generaloberst Hoth's counterpart. Rotmistrov saw Prokhorovka inexorably loom as the critical axis of the entire Kursk battle. To counter Hoth's 600 tanks,²¹ Rotmistrov had amassed approximately 850.²² In all there were some 1500 Russian and German tanks and assault guns committed to the battle at Prokhorovka which began on 12 July 1943.

The actual battle developed into a gargantuan mass of intertwined armour of both sides, in such close confines as to preclude maneuver in the classic style of German Panzer operations.

The German author Paul Carell quotes Rotmistrov:

"The tanks were moving across the steppe in small packs, under cover of patches of woodland and hedges. The bursts of gunfire merged into one continuous, mighty roar. The Soviet tanks thrust into the German advanced formations at full speed and penetrated the German tank screen. The T-34s were knocking out Tigers at extremely close range, since their powerful guns and massive armour (the German Tigers') no longer gave them an advantage in close combat. The tanks of both sides were in closest possible contact. There was neither time nor room to disengage from the enemy and reform in battle order, or operate in formation. The shells fired at extremely close range pierced not only the side armour but also the frontal armour of the fighting vehicles. At such range there was no protection in armour and the length of the gun barrels was no longer decisive. Frequently, when a

²¹Carell, Op. Cit., p. 30.

²²Caidin, M., The Tigers are Burning, p. 216, Hawthorn, 1974.

tank was hit, its ammunition and fuel blew up, and torn-off turrets were flung through the air over dozens of yards. At the same time over the battlefield furious aerial combats developed. Soviet as well as German airmen tried to help their ground forces to win the battle. The bombers, ground-support aircraft, and fighters seemed to be permanently suspended in the sky over Prokhorovka."²³

To support the heavily engaged units of Hoth's Fourth Panzer Army, Generalmajor Walter von Hünersdorff, the commander of the Sixth Panzer Division was ordered to attack the Soviet defensive zone between the Donets river and the town of Korocha. Von Hünersdorff succeeded and a bridge-head was established across the Donets at the village of Rahavets. Tanks from the Sixth, Seventh, and Nineteenth Panzer Divisions poured across the river and headed northward to the battlefield at Prokhorovka. Generalmajor von Hünersdorff had in fact moved so swiftly across the Donets that he and his divisional staff were the targets of a bombing attack by the Luftwaffe, which had not been informed that units of the Sixth Panzer Division were positioned on the northern bank of the Donets. Von Hünersdorff was wounded in the bombing attack, but the young general elected to stay with his unit at this critical stage of ZITADELLE.* The

*On 14 July 1943 Generalmajor von Hünersdorff was hit in the head by a sniper's bullet, he died three days later from brain damage while being attended by his wife, a nurse with the German Red Cross in Russia.

²³Carell, Op. Cit., p. 81-2.

climax to the battle was approaching on 13 July 1943, with von Hünersdorff's successful operation. The path was open for German armoured formations from Army Detachment Kempf to move unobstructed northward to Prokhorovka.

It was at this critical juncture, on 13 July 1943, that Hitler summoned the commanders of Army Group Center and South (von Kluge and von Manstein) to the Wolfschanze* at Rastenburg in East Prussia.

"Hitler informed Manstein at Kluge of what, in broad outline, they were already aware. On 10 July 1943, British, American, and Canadian troops had landed in Sicily from North Africa. Italian resistance on the island had rapidly collapsed. The 300,000 men, with the exception of a few units, had simply run away. The Allies were advancing along the coastal roads. The only resistance they were encountering was from German paratroops, Panzer Grenadiers, and anti-tank combat groups.

Hitler did not mince words when speaking of his Italian allies. He was not only angry, but anxious to the point of panic about the future development of the situation in southern Europe.

'Considering the lousy way the Italians are waging the war, the loss of Sicily is as good as certain. For all I know, Eisenhower may land on the Italian mainland or in the Balkans tomorrow. This would be a direct threat to our whole southern flank in Europe. That's what I've got to prevent. And that's why I need divisions for Italy and the Balkans. Now that I've moved First Panzer Division from France to the Peloponnese I've nowhere else to draw on, and that's why they have to be pulled out of Kursk front. I'm therefore obliged to suspend ZITADELLE.'²⁴

*Wolfschanze - Wolf's lair.

²⁴Ibid., p. 88.

Generalfeldmarschall von Kluge reported that Ninth Army was making no headway and he was having to use all of his mobile reserves to counter Soviet attacks into the German Orel salient to the north of Kursk. Von Manstein, on the other hand, retorted:

"Speaking for my own Army Group, I pointed out that the battle was not at its culminating point, and that to break it off at this moment would be tantamount to throwing a victory away. On no account should we let go of the enemy until the mobile reserves he had committed were completely beaten."²⁵

Hitler remained firm. ZITADELLE was terminated. The last great German offensive operation of the Eastern Front came to an inconclusive end--in the words of von Manstein in a fiasco. ZITADELLE became one more case of German tactical brilliance being defeated by German strategic misdirection, building a stronger case for von Manstein's book Verlorene Siege (Lost Victories).

To backtrack in time from 13 July 1943 to 8 July 1943, an important phase of ZITADELLE must be examined in more detail, in light of the Luftwaffe's anti-tank successes. The Soviet Second Guards Army had been placed between Hoth's Fourth Panzer Army and Army Detachment Kempf to prevent a joining of the two German forces. However, the situation

²⁵Von Manstein, Op. Cit., p. 449.

was developing at such a fast pace to the north, that the Soviets had to do something immediately to relieve the pressure being brought to bear by Hausser's Second SS Panzer Corps.

An armoured brigade was formed and dispatched to strike at the right rear flank of the SS Panzer Corps. The hastily assembled brigade consisted of 60 T-34 medium tanks and several rifle battalions.²⁶ The Soviet brigade was marched off in perfect formation on the morning of 8 July 1943. The operation would probably have done considerable damage to Hausser and, more importantly, upset the timetable for ZITADELLE, had the Luftwaffe not saved the day by using the HS129s of the Fourth Gruppe of Schlactgeschwader Nine to destroy the Soviet formation.

From the Luftwaffe point of view, the HS129-2/R-2 was the aircraft of the hour. These HS129s were solely responsible for knocking out the tanks of the Soviet armoured brigade near Byelgorod. The HS129 heretofore had not had a very noteworthy career. The original requirements for a close-air-support aircraft were laid out in 1937 by the Luftwaffe Technischeamt (Technical office). These requirements included: a relatively small but heavily armed and

²⁶Carell, Op. Cit., p. 75.

armoured aircraft, with two low-powered engines, 75mm armour-glass glazing for the cockpit, armour protection for both engines and crew, and a fixed forward firing armament of at least two 20mm cannons plus machine guns.²⁷ Additionally, the specifications called for an aircraft that did not have excessively high speed, so that the pilot would have added accuracy when delivering ordnance on enemy positions.²⁸

The HS129 prototypes were equipped with two Argus AS 410A-1 12 cylinder inverted-Vee air-cooled engines, each rated at 465 HP for take-off and 415 HP at 7,865 feet. From the beginning of the test program it became apparent that the aircraft was seriously underpowered, even without weapons uploaded. The prototype was sluggish in the air, had poor acceleration and marginal maneuverability. The Luftwaffe categorically refused to accept the proposed production model of the HS129.

After the defeat of France in June 1940, the Henschel factory gained access to the French firm of Gnôme-Rhône which produced an engine suitable for mounting in the HS129 airframe. The Gnôme-Rhône 14M/5 engine was rated at 700 HP

²⁷Green, W., The Warplanes of the Third Reich, p. 390, Doubleday, 1970.

²⁸Feist, U. and Dario, M., Luftwaffe in Action, p. 8, Squadron/Signal, 1972.

for take-off and 660 HP at 13,200 feet. Mating two of these engines to the HS129 markedly improved the performance of the aircraft.

With the decision in mid 1941 to expand the number of Schlachtflugzeuge (close-air-support aircraft) after the successful employment of the dated HS123 biplane, the HS129 program was suddenly given top priority.²⁹ Priority was so high in fact that even preproduction HS129B-0s were used to partially outfit the Fourth Staffel of Schlachtgeschwader One in January of 1942. The lack of sufficient testing and the urgency placed on forming the new units caused some serious problems with the Gnôme-Rhône engines to be overlooked. The engine had a tendency to seize without notice and it proved incapable of absorbing even the slightest battle damage. The engines were also extremely sensitive to dust and sand and therefore could only be operated from grass or paved surface airfields. A full five months were to pass before another Staffel was outfitted with HS129s.

By July of 1943 four HS129 Staffeln were operationally ready and serving in combat on the Eastern Front.³⁰ All four Staffeln came under the control of Führer der

²⁹Green, Op. Cit., p. 393.

³⁰Mahlke, H., Nahkampfflieger Verbände, p. 61, Schwieger und Pick Verlag, 1971.

Panzerjägerstaffeln (Commander of anti-tank squadrons).

These four Staffeln of HS129s comprised the Fourth Gruppe of Schlachtgeschwader Nine. The Fourth Gruppe then consisted of four Staffeln with 16 HS129s each plus a Stab (staff) flight with 4 aircraft, making a total of 68 HS129s. The Fourth Gruppe was based as a unit near Mikoyanovka, Russia (just north of Kharkov). This Gruppe was the airborne anti-tank unit which, through its air attacks on 8 July 1943, removed a Soviet armoured brigade from the Russian order of battle.

The Fourth Gruppe was reorganized shortly after ZITADELLE (18 October 1943). Its new establishment was:

FOURTH GRUPPE OF SCHLACHTGESCHWADER NINE

Stab IV(Pz)/StG 9

10th Staffel (Pz)/StG 9

11th Staffel (Pz)/StG 9

12th Staffel (Pz)/StG 9

13th Staffel (Pz)/StG 9

14th Staffel (Pz)/StG 9

(11th (Pz)/StG 9 was withdrawn from combat on 27 December 1943 and reformed as a test Staffel in Germany).

The primary anti-tank weapon carried by the HS129s of the Fourth Gruppe was the Bordkanonen MK 101. The MK 101 cannon was carried on the centerline station of the HS129



The HS129



The HS129

and could be removed easily if required. The removal was in fact a common practice, especially in late 1942 when there were few armoured targets and the HS129s were concentrated on close-air-support missions. The addition of the MK 101 weapons pack seriously disrupted the aerodynamics of the HS129; so much so that the maximum speed with the MK 101 cannon pack was only 199 MPH.³¹ The HS129 could carry 30 rounds of 30mm Wolfram ammunition.

Basic specifications for the HS129B-2 are as follows:³²

TYPE

Single-seat close-air-support and anti-tank aircraft.

POWER PLANTS

Two Gnôme-Rhône 14M 4/5 14 cylinder radial air-cooled engines each rated at 700 HP for take-off and 660 HP at 13,200 feet altitude.

ARMAMENT

(standard) Two 7.9mm machine guns with 500 r.p.g. and two 20mm MG 151 cannon with 125 r.p.g. plus one 30mm MK 101 cannon with 30 rounds.

(variation) One 550 pound SC 250 bomb beneath the fuselage, and two 110 pound SC 50 bombs, or 48 4.4 pound SD 2 bombs beneath the wings.

(variation) Four 7.9mm MG machine guns with 250 r.p.g. four 110 pound SC 50 bombs, 96 4.4 pound SD 2 anti-personnel bombs.

(variation) HS129B-2Wa, standard built-in gun armaments and one 30mm MK 103 cannon or two 20mm MG 151 cannon and one 37mm BK 3.7 cannon.

³¹Green, Op. Cit., p. 397.

³²Ibid.

PERFORMANCE

Maximum speed 253 MPH at 12,570 feet; (with 30mm MK103 cannon 199 MPH at 9,845 feet); range 428 miles (with 30mm cannon 348 miles); cruising speed 196 MPH at 9,845 feet; initial climb rate 1,595 feet per minute; ceiling 29,530 feet (with 30mm cannon 24,600 feet).

WEIGHTS

Empty 8,400 pounds, empty equipped 8,860 pounds, empty equipped with external 30mm cannon 9,243 pounds; maximum loaded 11,574 pounds.

DIMENSIONS

Span 46 feet 7 inches; length 31 feet 11 3/4 inches; height 10 feet 8 inches; wing area 312 square feet.

The Fourth Gruppe with its HS129s had only recently been organized as an integral unit on the Eastern Front. Due to previous technical and mechanical difficulties the HS129s did not enjoy a reputation for reliability. They were, however, figured into the battle plan of ZITADELLE and one can speculate in light of subsequent performance, that their commander had created a "can do" atmosphere of considerable proportions. As the 8th of July 1943 dawned, the battle had not yet reached its climax, but as the reader will shortly see, the Second SS Panzer Corps was courting disaster.

A pictorial view of the Fourth Gruppe's operations against the Soviet armoured brigade is presented in Figure 3. As previously mentioned, and as is obvious from the accompanying figure, the Second SS Panzer Corps was in very

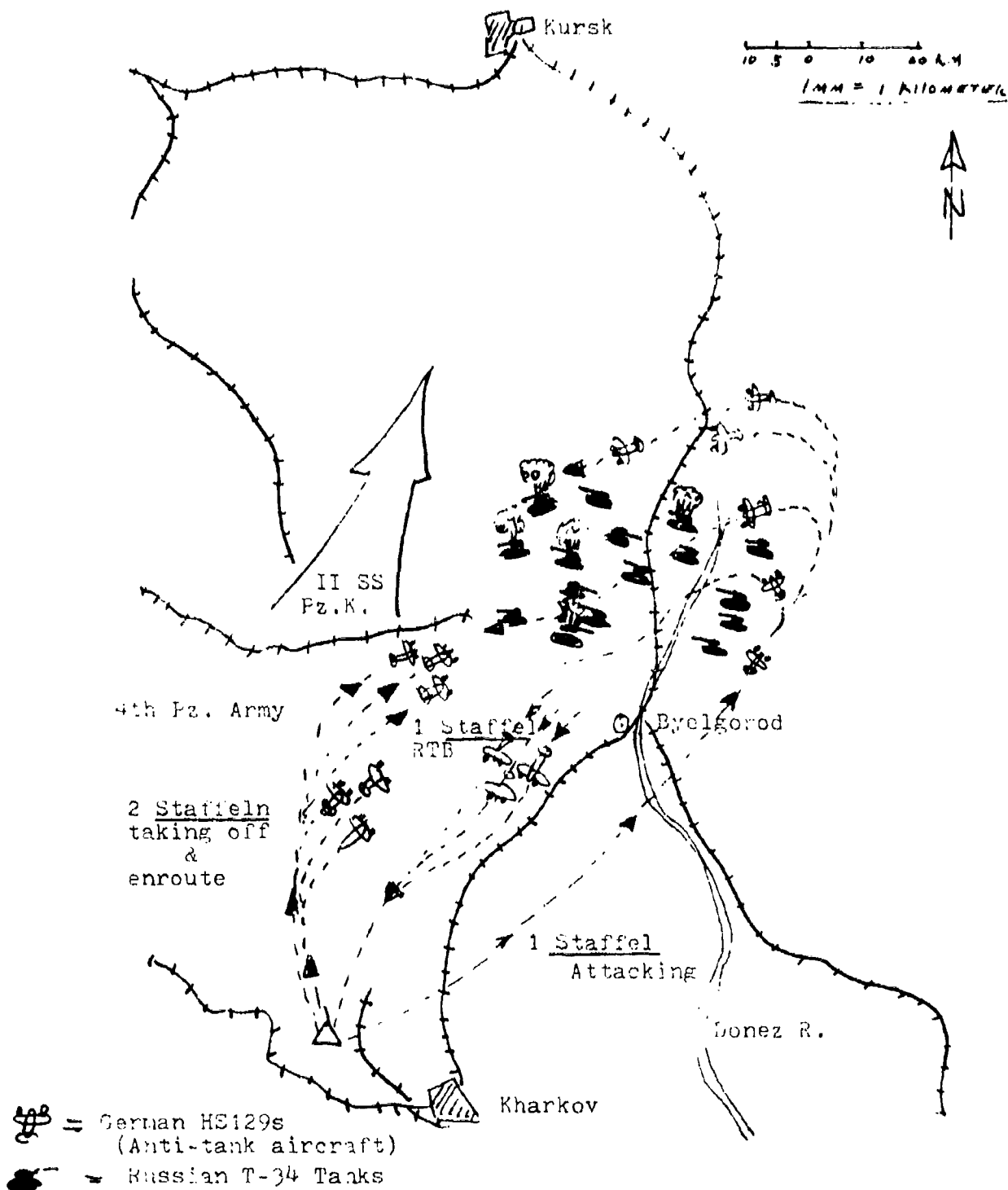


Figure 3
Operation of the Fourth Gruppe of Schlachtgeschwader Nine
8 July 1943

difficulties as the Soviet armoured force was approaching. General der Waffen SS Hauser would have had all the makings of catastrophe, had the Russian forces succeeded in effecting contact with the Second SS Panzer Corps exposed right rear flank.

The Gruppenkommandeur of Fourth Gruppe, Schlachtgeschwader Nine, Hauptmann Bruno Meyer, was leading a Rotta (3 aircraft) of HS129s on a reconnaissance mission over the wooded area of Gotishchevo, Russia in the early morning of 8 July 1943. As a Gruppenkommandeur and therefore participant at VII Fliegerkorps headquarters conferences, Meyer was privy to the disposition of all German ground forces in the area. Hauptmann Meyer spotted the Soviet brigade and instantly realized the threat to the Second SS Panzer Corps.

Meyer alerted the other Staffeln of his Gruppe, via radio, to prepare for battle. This was to be the first confrontation in history of an armoured force on the ground being attacked from the air alone, with no coordination or support from friendly ground units. Gruppenkommandeur Meyer also alerted Major Druschel's FW190 Schlachtgruppe which was to assist in attacking the accompanying Russian infantry and Flak with high-fragmentation bombs.

In order to keep constant pressure on the enemy and avoid a premature disengagement on behalf of the Soviets,

Meyer formed his Gruppe into four flying Staffeln of nine aircraft each. As the one Staffel was returning to the airfield after expending its ordnance on the Russians, the second Staffel was engaged with the enemy, the third was enroute to the battle, and finally the fourth was refueling and arming on the ground. Simultaneously FW190s would follow similar procedures, but in lieu of tanks the FW190s would concentrate on attacking associated personnel and Flak emplacements.

The HS129 pilots' tactics would be to attack from very low level and fire their 30mm cannon at the side, rear, and engine decking of the Russian tanks. The penetration capability of the MK 101 30mm round, with the tungsten-carbide core, was 80mm of armour³³ which was sufficient to knock out a T-34 from the rear hull (45mm of armour) or hull roof (18-22mm of armour). It was only possible for the HS129s to use these low level tactics, and fire at minimum slant range because the FW190s coordinated to suppress the ground fire from anti-aircraft guns and from infantry small arms and automatic weapons.

"It was a battle of machines. The Russian tanks were unable to cope with this unaccustomed attacker. They drove across each other's paths, got mixed up

³³Bekker, Op. Cit., p. 437.

with one another, and fell an easy prey to Meyer's flying tank busters."³⁴

The Russian armoured brigade was destroyed by the quick and decisive interdiction of the anti-tank Fourth Gruppe. The entire operation was over in one hour. The elements of success on the German side were mainly due to the authority and competence possessed by lower echelon Luftwaffe field commanders, as well as the skill and aggressivity of the individual pilots. Bruno Meyer, only a Hauptmann at the time, used his initiative and aggressively employed his forces to counter a massed enemy concentration of armour. Hauptmann Meyer did not request authority from a distant command center, he realized the critical position of the Second SS Panzer Corps and he took immediate action to redress the critical situation facing his comrades on the ground. Meyer accentuated his unit's success by a careful coordination of his four individual Staffeln so that the enemy was never given an opportunity to rest, regroup, or disengage. Gruppenkommandeur Meyer also contacted supporting Luftwaffe units to suppress ground fire enabling the HS129s to operate at optimum effectiveness, i.e. low altitude and minimum slant range at firing. Hauptmann Meyer

³⁴Carell, Op. Cit., p. 76.

must have also had an excellent ground maintenance organization which could rapidly refuel, reload and relaunch the returning HS129s.

In recounting the successes of this historic first aircraft/tank battle, the winning side possessed several noteworthy characteristics. The German HS129 Kommandeur used aggressive tactics, close coordination, rapid generation of sorties, and the old Prussian dictum "Schussfeld geht vor Deckung."* The higher echelon Luftwaffe commands were also cognizant of the fact that in order to use resources at the optimum level, the lower echelon commanders must be given the authority commensurate with their responsibilities. In a resource poor army, every attempt must be made to utilize those resources available in the most efficient and effective manner possible. The actions of the Fourth Gruppe, Schlachtgeschwader Nine on 8 July 1943 are evidence of the wisdom of this policy.

Viewing the situation in Europe today, with the masses of Soviet armour opposing the qualitatively superior NATO formations, Bruno Meyer's operation of 8 July 1943 can be a valuable core of experience. Of course one can never fight a battle before it begins. Frequently, however, the successful

*"Obtain a field of fire before cover."

field commander is the one who can take advantage of an unforeseen opportunity that develops after the battle has begun. Prior to the battle one can only use what information is available at that time.

The assumption here is that NATO can use the A-10 (or similar 30mm cannon equipped tactical aircraft) to effectively combat the disproportionate number of Warsaw Pact tanks. The actions of the HS129s at ZITADELLE proved the practicality of using aircraft--unsupported by friendly ground troops--to destroy large enemy armoured formations. An analogous situation exists today in Europe with NATO facing a numerically superior, but qualitatively inferior, Warsaw Pact. All that is needed to complete the formula for NATO success, in using aircraft against tanks, is an update of the same basic tactics used by Bruno Meyer in July 1943.

Among unclassified sources, the "Sokolovsky Papers" are a prime informant of contemporary Russian military thought. Sokolovsky emphasises that the massing of armour is still the vital component in the "mass assault in the necessary locale." However, with the advent of nuclear weapons these forces must be dispersed prior to and after the massing for a break-through in order to preclude a tempting nuclear

target.³⁵ Sokolovsky stresses the need for "exceptional flexibility" so that forces can concentrate and quickly disperse again. It is at this point, of quick concentration of Soviet forces, that NATO anti-tank aircraft can be most effective. If the Russians do indeed follow these tactics, then speed is of the utmost criticality in countering the massed Soviet armoured formations. If the Soviets can rapidly concentrate, attack, and subsequently disperse, then NATO must counter these formations at the critical time frame of concentration prior to attack. At this critical juncture, flying anti-tank artillery is a weapon which has, to date, not been exploited to anywhere near its potential.

Based on the "Meyer Model," there is proof that aircraft without the support of ground forces can effectively neutralize enemy armoured formations. It is important to note, that the "Meyer Model" is not a mathematical game or abstract theory, the "Meyer Model" is fact. From this factual model one can extract the elements that constituted success and apply these elements to the probable scenario in Europe.

From the historical case it appears certain that the tank destroying aircraft can add increased effectiveness

³⁵Wolfe, T., Soviet Power and Europe 1945-1970, p. 201, John Hopkins, 1970.

and flexibility to NATO. With properly developed tactics and aggressive implementation of them, in NATO, one could theorize that an airborne anti-tank weapon system, which can project the power of NATO well beyond the front lines, could effect a neutralization of the Warsaw Pact's armoured forces without resorting to the nuclear option.

CHAPTER V

Environment 1976

Looking at a map of Europe depicting the disposition of Warsaw Pact anti-aircraft defenses, has a very sobering effect on any proponent of an aggressive NATO airpower strategy. Much of the shock, especially to USAF personnel, is a result of the relatively permissive environment encountered during the Indo-China War. With the exception of the major population centers of North Vietnam, and a few local concentrations in South Vietnam and Laos, anti-aircraft defenses were light to non-existent.* With the recent experience in Southeast Asia, a basic reorientation to Europe is necessary on behalf of the USAF.

One can hypothecate that tactical aircraft losses will be quite high--regardless of the mission. The Russians view any hostilities in Europe as in the context of a short and decisive drive to the English Channel. The NATO air forces must be able to counter this Soviet thrust before its momentum builds up to the point where it will overwhelm the NATO

*The author was assigned to SEA on four occasions over the 1969-74 time frame, flying three different tactical aircraft (F-4, A-7, F-105), and flying in North Vietnam, South Vietnam, Laos, and Cambodia.

ground forces. In countering this Soviet thrust, NATO losses in tactical aircraft will be quite high, but considering the criticality of the threat and projected short duration of the conflict, they must be accepted, assuming NATO is serious about its mission.

In observing the potential anti-aircraft threat in Europe, one is confronted with an assortment of radar SAMs, infrared SAMs and radar controlled AAA. The primary concern here is with aircraft carried 30mm cannon attacks against tanks. It has been demonstrated historically that bombs are not as an effective air-to-ground weapon for use against tanks as 30 and 37mm airborne cannons (see previous chapters). There is no substantial evidence to support any change in this historical precedent. As such, with the optimum slant range of the GAU 8 30mm cannon at around 4000 feet slant range, tactical aircraft attacking tanks can expect to be exposed to all three of the above mentioned anti-aircraft systems. The high concentration of such anti-aircraft systems in the Warsaw Pact will therefore extract a high toll of NATO aircraft especially in the lower altitudes where the anti-tank aircraft must operate to be effective.

The legacy of Vietnam with the emphasis by USAF commanders, in that theatre, on safety and sorties rates has permeated the

USAF tactical doctrine. Considering the short duration of projected operations in Europe, a basic reorientation of attitudes on behalf of the USAF and its tactical commanders is a vital prerequisite to successfully begin to counter the Soviet threat in Europe.

Viewing the anti-aircraft order of battle in East and Central Europe it is apparent that NATO will be taking very heavy losses in close-air-support operations behind the enemy lines. Airpower, however, does offer the capability to strike the massing enemy prior to the enemy's attack in force. NATO must, however, be prepared to accept high aircraft losses to effect a neutralization, or at least blunting of the enemy armoured striking forces. NATO's air forces, then, must select the optimum aircraft(s) to maximize the damage to the enemy while minimizing the cost to NATO.

The accompanying chart (see figure 4) depicts the ground-based air defense potential of a Soviet Army Group (3-4 Divisions). There are five Soviet Army Groups stationed in the GDR (48:183) and each Army Group controls an air defense sector approximately 50 kilometers wide and 100 kilometers deep. The following air defense weapons and numbers thereof are organic to a Soviet Army Group.

¹Miller, R., "Europe's New Generation of Combat Aircraft Part 1 - The Increasing Threat," International Defense Review, p. 183, April 1975.

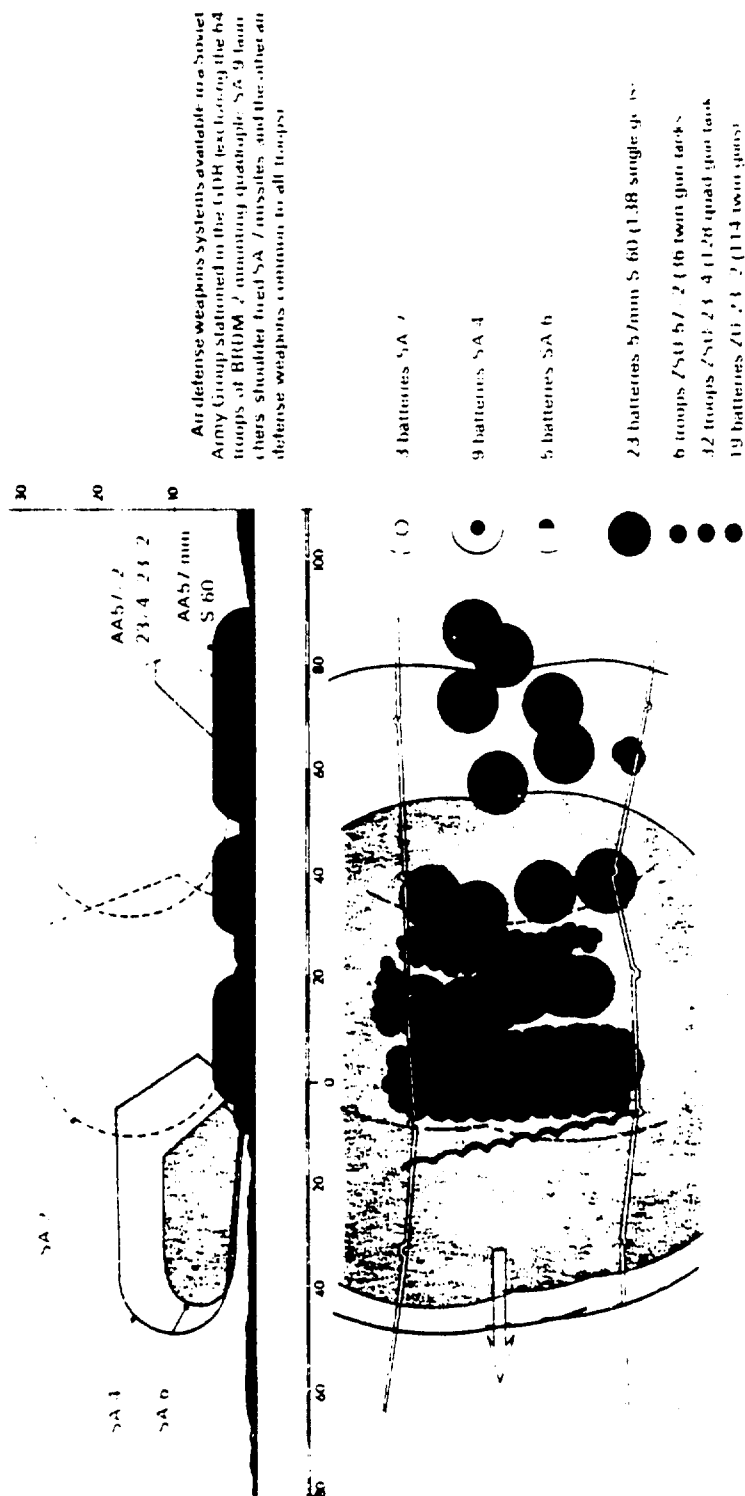


Figure 4
Soviet Army Group Air Defense Net.

ZU-23-2- A total of 114 of these towed 23mm twin cannon are deployed along the front-line of each Soviet Army in a 5 km wide belt, and also generally within the operational area. They are deployed in 19 batteries of six mounts each. The anti-aircraft range of these weapons is 1,200 m. and the theoretical maximum rate of fire is 2,000 rpm.

ZSU-23-4- 32 batteries of the 23mm quad cannon-armed Shilka AA tank, forming a total of 128 vehicles are also deployed along the 50 km front line, and generally throughout the operational zone. The ZSU-23-4 radar-directed mount has a theoretical maximum firing rate of 4,000 rpm, and an effective range of 2,500m. It showed itself to be a most lethal and effective low-level AA weapons system during the October War.

ZSU-57-2- This twin 57mm AA tank is deployed in smaller numbers throughout the Army area, with a total of 36 vehicles divided into 6 batteries. The optically-controlled automatic cannon have a combined rate of fire of 240 rpm, and are effective to a range of over 4,000 m. at high angles of elevation.

S-60- This radar-directed, single barrel towed AA gun uses the same 57mm ordnance as the ZSU-57-2. Its rate of fire is 120 rpm, and the effective range is well over 4,000m. A total of 138 guns (in 23 batteries each with six guns) are deployed in three belts across the breadth of each Soviet Army area. The first belt is about 10 km. behind the Soviet front line, with the second 15 km. and the third about 25 km. behind.

SA-6- 5 batteries of the SA-6 missile system (each consisting of one Straight Flush fire control radar vehicle, one loader vehicle, and 3 twin launcher vehicles) move close to the front of the advancing Soviet Army Group. Three further batteries are located 5 km behind the front line. They cover the whole 50 km. front of that Army Group's area, extending up to 32 km. into NATO airspace at the maximum altitude of 10,000 m., and up to 10 km. at an altitude of 100 m. with an effective engagement radius of 5 km. The two remaining batteries are deployed in depth, some 10 km. further to the rear, filling the central gaps between the three forward batteries.

SA-4- 9 mobile SA-4 missile batteries are deployed in the gaps between the SA-6 batteries. Each SA-4 battery has one Pat Hand fire control radar, one loader vehicle, and three twin launcher vehicles. The leading 3 batteries move at a distance of 10 km. behind the Army Group's frontal units, reaching up to 50 km. into NATO airspace at the maximum altitude of about 15,000 m. The 6 remaining batteries move in a lateral belt 25 km. behind the front, backing up the 2 rear SA-6 batteries.

SA-2- Three batteries, each with 6 single SA-1 mobile missile launchers, a Fan Song fire control radar, and a loader vehicle, are deployed in the Army Group area. The two forward batteries are located 45 km. from the Soviet front. They can cover a range of about 8 km. beyond this front, against medium/high altitude targets, to a maximum altitude of about 25,000 m. The third SA-2 battery is located in the center of the Army Group area, some 80 km. behind the advancing front.

The above described systems do not indicate the air defense weapons common to all troops (rapid-fire AA guns, MGs), SA-7s, and 64 troops of BRDM-2 vehicles mounting quadruple SA-9 launchers.² A discussion of the possible weaknesses of the above air defense system will be included in the concluding chapter.

One can expect the attacking enemy armoured units to lose some of their anti-aircraft capability as they advance into friendly territory. This is due to the normal logistical strains put on any attacking forces as it advances with the accompanying lengthening of the distance from the source

²Ibid.

of supply. In effect then, the attacking armoured units can be expected to lose a portion of their striking power and defensive capability as they advance. Herein lies the paradox: the enemy forces are more vulnerable as they advance, but they are closer to friendly critical positions; conversely if the friendly anti-tank aircraft are directed at armoured units beyond the FEBA into enemy territory, attacking aircraft will suffer higher losses, but they will also blunt/neutralize the enemy's attacking strike force.

Although there has, of late, been considerable interest and advancement in anti-tank weaponry, such as the TOW missile and the GAU 8 30mm cannon, the Soviets still consider the tank as the weapon system around which a striking force is composed. The Soviets have, in fact, increased the importance of their tanks:

"Ironically then, the recent Soviet concern over anti-tank weapons has actually raised rather than lowered the status of the tank. Practically all of the articles have emphasized the greater vulnerability of the BMP. It is the BMP, not the tank, which is perceived as the weak link in the combined arms chain."³

NATO is back to the position of facing an enemy bent on maintaining the offensive. Anti-tank aircraft offer NATO

³Karber, Phillip A., "The Soviet Anti-Tank Debate," Survival, Volume XVIII, Number 3, p. 109, May/June 1976.

the option of blunting this massive enemy attack before its full offensive weight can fall on NATO ground forces. Is the potential loss in anti-tank aircraft worth the gain?

Before considering the above question an examination of NATO anti-tank aircraft is in order. Chapter VI will cover the A-10. Chapter VII will examine the alternatives; the A-7 and the F-16.

CHAPTER VI

The A-10

The A-10 is the first new generation USAF aircraft specifically designed for the close-air support mission. Close-air support is defined by the Joint Chiefs of Staff as:

"Air attacks against hostile targets which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of those forces."

As a result of air operations in SEA it was apparent that the USAF did not possess a weapon's system that was specifically tailored for the close-air support mission. The A-10 is an attempt to fill this void. The basic consideration for fulfilling the CAS mission require an aircraft that can carry a large payload over a reasonable distance, loiter in the target area for a considerable time, operate under low ceilings in reduced visibility and finally to provide the accuracy necessary to support troops in contact.

An additional role of close-air-support is of course countering enemy armoured formations. In this area the potential represented by the A-10 with the 30mm GAU 8 cannon is a quantum leap over previous tactical aircraft capabilities

against armoured vehicles. With the large disparities in NATO armoured forces facing the armoured forces of the Warsaw Pact, mentioned in previous chapters, the A-10 anti-tank features represent a capability of tremendous advantage in the European environment.

There are of course many uncertainties that preclude an exact accounting of the effectiveness of the aircraft anti-tank mission, however, there is not any question that the A-10 represents an unparalleled advance over previous tactical aircraft in the anti-tank role. The ultimate test of how effective tactical airpower will be in the anti-tank mission can only be evaluated after combat operations commence.

Figure 5 on page 117 illustrates a number of possible combat scenarios for the A-10. The relatively low fuel consumption and high payload capability of the A-10 are major advantages in its flexibility. Basic specifications for the A-10 are as follows:¹

A-10 Performance Characteristics:

Close air support radius	250 N.MI
Loiter at CAS radius	2 hours
Reconnaissance radius	406 N.MI
Escort radius	258 N.MI

¹Fairchild Republic, A-10, Fairchild Industries, p. 7, 1975.

Ferry range	2365 N.MI . .
Sustained load factors	
at 150 Kts.	2.29 G
at 275 Kts	3.26 G
Instantaneous load factors	
at 150 Kts.	2.34 G
at 300 Kts.	5.93 G
Combat speeds	
with 6 MK-82 Bombs at 5000 Ft.	385 Kts.
clean sea level	390 Kts.
stabilized 45 degree speed	260 Kts.
Take-off distance	
Maximum gross weight	3850 feet
Forward airstrip weight	1130 feet
Landing distance	
Maximum gross weight	2140 feet
Forward airstrip weight	1085 feet

Dimensions

Total aircraft	
Wing span	55 Ft 0 in
Length	53 Ft 4 in
Height	14 Ft 8 in
Horizontal tail span	18 Ft 10 in
Wheel Tread	17 Ft 2.6 in
Wheel Base	17 Ft 8.76 in

Operational Mission Weights

	<u>Max take-off</u>	<u>Forward airstrip</u>
Weight	45,560 lbs	30,344 lbs
Number of pylons	11	11
Ammo rounds	1,350	750
External ordnance	9,540 lbs	2,120 lbs
No of MK 82 bombs	18	4
Internal fuel	10,650 lbs	4,228 lbs

Sustained Turn Radius (5000 ft., tropical day, 6 MK 82s)

20 degree flaps	130 Kts.	1003 ft
	150 Kts.	972 ft
	170 Kts.	1176 ft
No flaps	200 Kts.	1305 ft
	250 Kts.	1864 ft
	300 Kts.	2598 ft

The heart of the A-10 weapons system is the General Electric GAU 8 30mm cannon. Basic characteristics of the cannon are as follows:²

Gun System Characteristics

Gun	7 barrel Gatling
Weight	
Feed System	1150 lbs.
Mount	73 lbs.
Gun	620 lbs.
Drive & Controls	120 lbs.
Ammunition	2066 lbs.
Total	4029 lbs.
Firing Rate	2100/4200 spm
Ammunition Capacity	1350 rounds
Feed System	Double-ended linkless
Drive System	Dual hydraulic motors
Power Requirements	77 HP
Barrel Life (per set)	21,000 rounds (minimum)
Time to Rate	0.55 second
Dispersion - 80%	5 mil
Average Recoil Force	10,000 lbs.
Reliability	10,000 MRBF
Design Burst Length	10 2 second bursts with 1 min. cool time between bursts.

²General Electric, Gun Weapons System, General Electric, 1975.

GAU-8/A Ammunition Characteristics

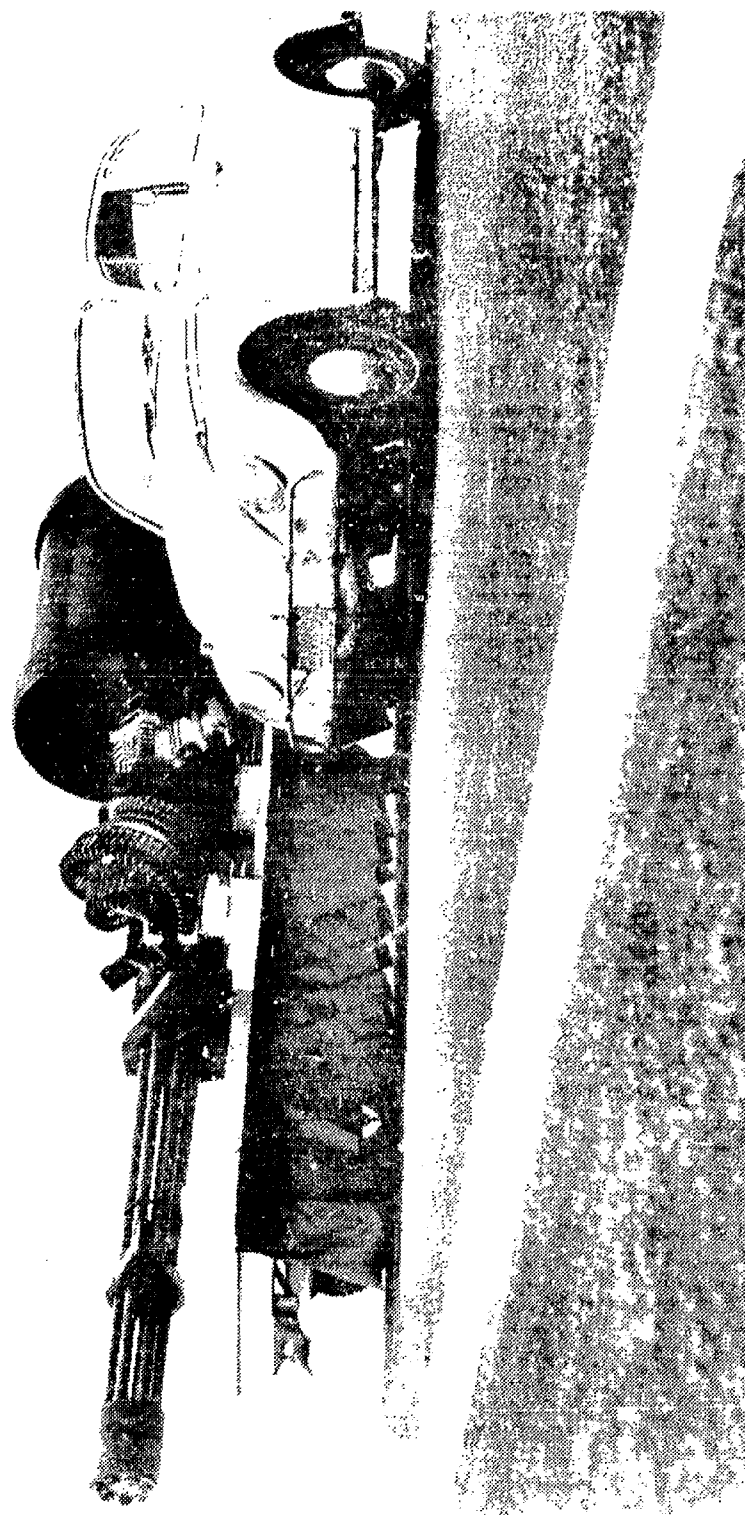
GAU-8/A Ammunition	TP/HEI	API
Cartridge Weight	1.530 lb.	1.65 lb.
Projectile Weight	0.814 lb.	.94 lb.
Case Weight (7475 alum)	0.322 lb. avg.	--
Propellant Weight	148-156 gms.	150-156 gms.
HE Weight	56 gms. min	X
Cartridge Length	11.416 in. max.	
Projectile Length	5.49 in. max.	
Case Length	6,811 in. max.	
Muzzle Velocity	3,400-3,450 ft/sec.	3,240 ft/sec.

GAU 8 Ammunition:³

The GAU-8/A 30mm ammunition consists of a family of ballistically matched projectiles which are currently under development. They include Target Practice (TP), High Explosive Incendiary (HEI) and Armour Piercing Incendiary (API) rounds which are designed to defeat a wide range of close air support targets such as trucks, armoured personnel carriers and medium and heavy tanks. The HEI round employs a standard M505 fuze and explosive mix with a body of naturally fragmenting material that is effective against lighter vehicle and materiel targets. The API round has a light weight body which contains a subcaliber high density penetrator of depleted uranium. The ballistics are optimized to provide the maximum remaining energy at combat ranges sufficient to defeat tanks and armoured personnel carriers.

The GAU-8/A ammunition incorporates aluminum cartridge cases which reduce system weight significantly over brass or steel cases. The round is percussion primed and the projectile uses plastic rotating bands instead of the conventional copper or steel bands which significantly improves barrel life.

³Ibid.



The 30mm General Electric GAU-8 Cannon



The GAU-8 installed in the A-10.

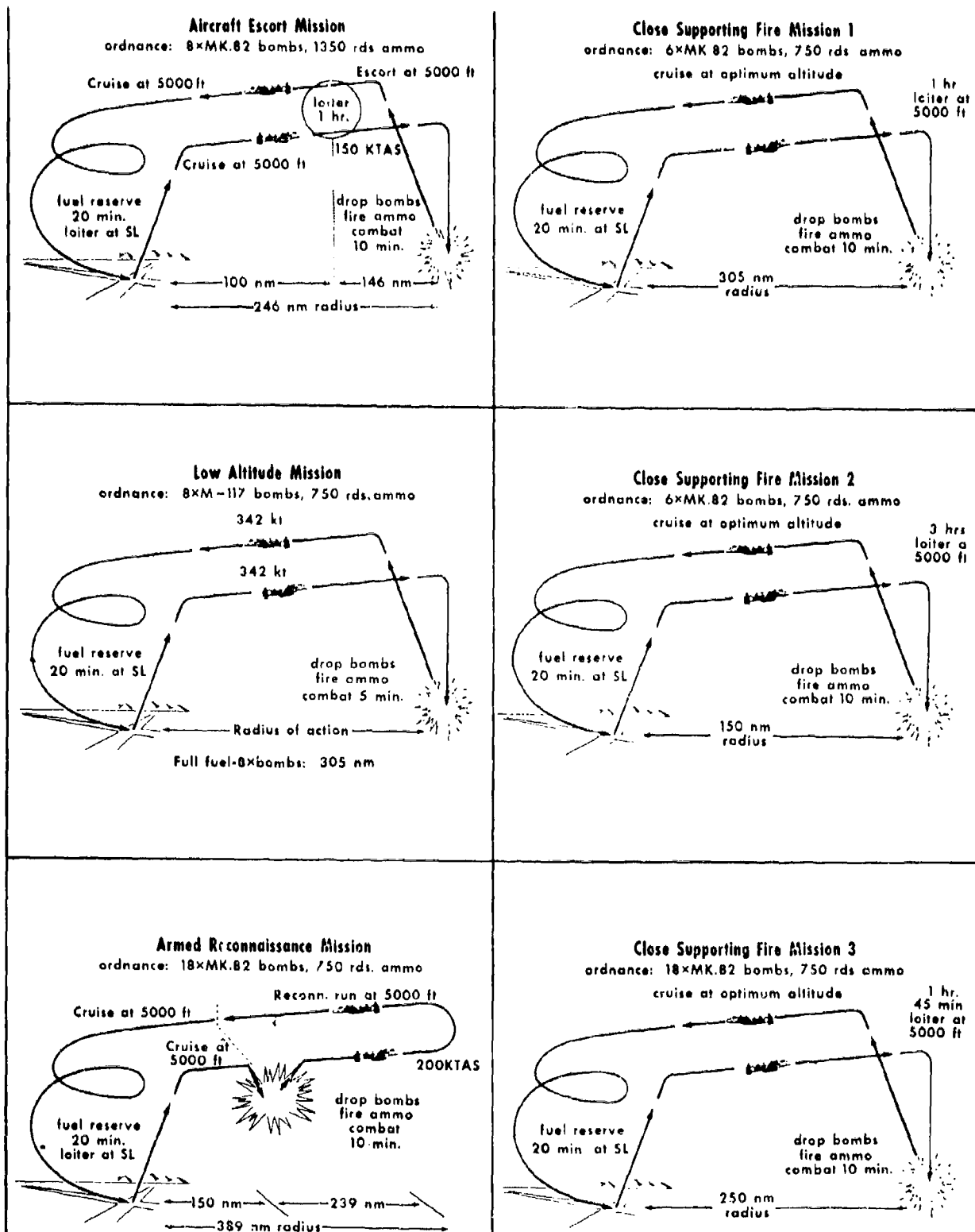


Figure 5
 A-10 Combat Scenarios

As a general comment on the A-10, one can say the key to the aircraft's success lays in its ability to survive in the heavily defended European environment. The main advantages of the A-10 are: its rough and rugged construction, armour protection for the pilot and vital systems of the aircraft, the high payload capacity, the long loiter time, and weapon's delivery accuracy. The A-10 also has the capability for landing on unimproved airstrips and for relatively short take-off and landing distances.

The main disadvantages of the A-10 are its slow speed and large plan form. As such the A-10 is more likely to be hit by AAA fire, although if hit the A-10 is more likely to survive than conventional tactical aircraft without the survivability features possessed by the A-10. One must temper this slow speed characteristic with the realization that speed is not an advantage when searching for concealed enemy (personnel or equipment) on the ground. In Oberst Rudel's words "When searching for hidden tanks, speed is poison."* The A-10 will also be able to operate in minimal weather conditions where normal tactical aircraft at present cannot.

*Statement made by Oberst Rudel at Anti-Tank Conference, 14 October 1976.

CHAPTER VII

The Alternates

For purposes of this thesis, two alternate anti-tank aircraft will be discussed: the A-7 and the F-16. Both aircraft, in preliminary studies, have been found to be compatible with the 30mm D.U. ammunition used in the GAU-8 cannon.

The F-16 can carry the POD version GE cannon designated the GAU-8A, however the F-16 appears to be more compatible with a POD version of the Oerlikon KCA 30mm cannon (the license for U.S. production held by Hughes Aircraft which offers the Oerlikon KCA in an internal mounting -- see Figure 6).

The A-7 is an all weather, single seat, sub-sonic attack fighter currently in operation with the USAF Tactical Air Command. The A-7 is a combat tested weapons system, which was used extensively in the Vietnam conflict by the U.S. Navy and USAF. Basic characteristics of the A-7 are:¹

¹Jane's All the World's Aircraft, p. 321, Jane's Yearbook, 1975.

Dimensions, External:

Wing span	38 ft 9 in (11.80 m)
Width, wings folded	23 ft 9 in (7.24 m)
Wing chord at root	15 ft 6 in (4.72 m)
Wing chord at tip	3 ft 10 $\frac{1}{4}$ in (1.18 m)
Wing aspect ratio	4
Length overall	46 ft 1 $\frac{1}{2}$ in (14.06 m)
Height overall	16 ft 0 $\frac{3}{4}$ in (4.90 m)
Tailplane span	18 ft 1 $\frac{1}{2}$ in (5.52 m)
Wheel track	9 ft 6 in (2.90 m)

Areas:

Wings, gross	375 sq ft (34.83 m ²)
Ailerons (total)	19.94 sq ft (1.85 m ²)
Trailing-edge flaps (total)	43.48 sq ft (4.04 m ²)
Leading-edge flaps (total)	48.74 sq ft (4.53 m ²)
Spoiler	4.60 sq ft (0.43 m ²)
Deflector	3.44 sq ft (0.32 m ²)
Fin	111.20 sq ft (10.33 m ²)
Rudder	15.04 sq ft (1.40 m ²)
Horizontal tail surfaces	56.39 sq ft (5.24 m ²)
Speed-brake	25.00 sq ft (2.32 m ²)

Weights:

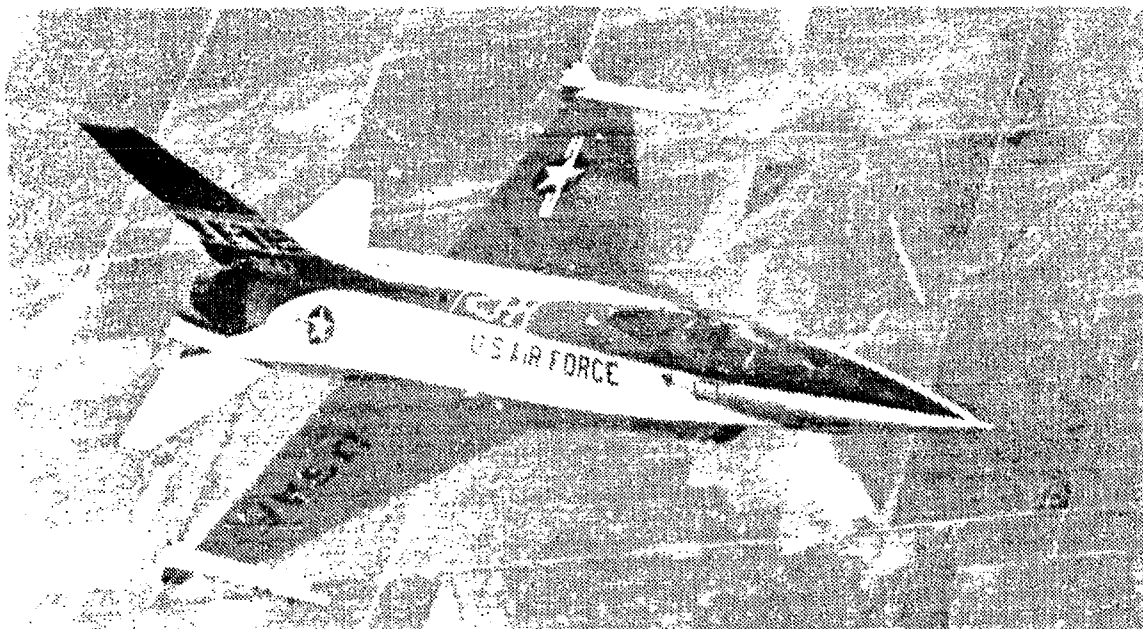
Weight empty	19,781 lb (8,972 kg)
Max T-O weight	42,000 lb (19,050 kg)

Performance:

Max level speed at S/L	606 knots (698 mph; 1,123 km/h)
T-O run at max T-O weight	5,000 ft (1,525 m)
Ferry range:	
max internal fuel	1,981 nm (2,281 miles; 3,671 km)
max internal and external fuel	2,494 nm (2,871 miles; 4,621 km)



The USAF LTV A-7.



The General Dynamics F-16.

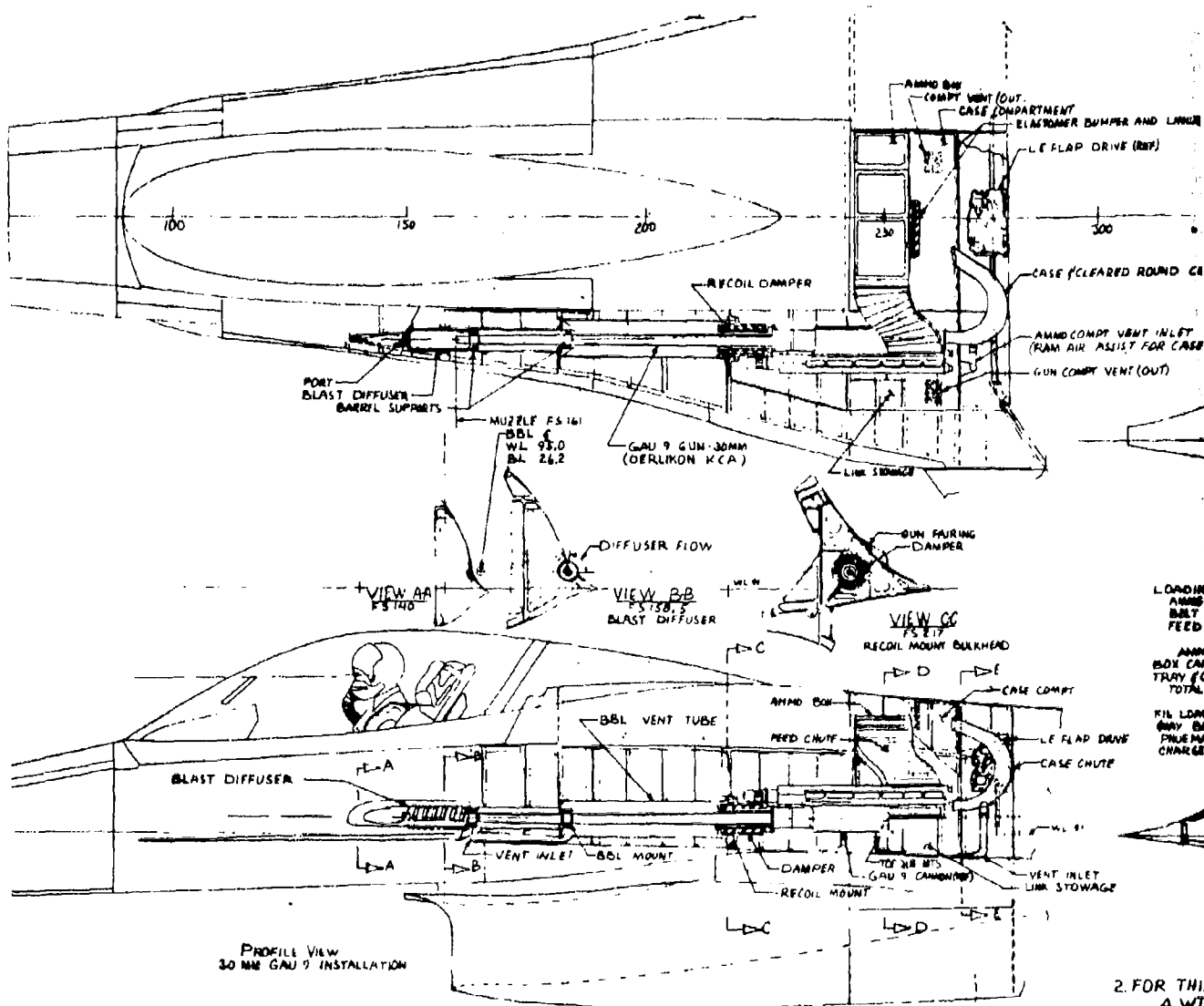
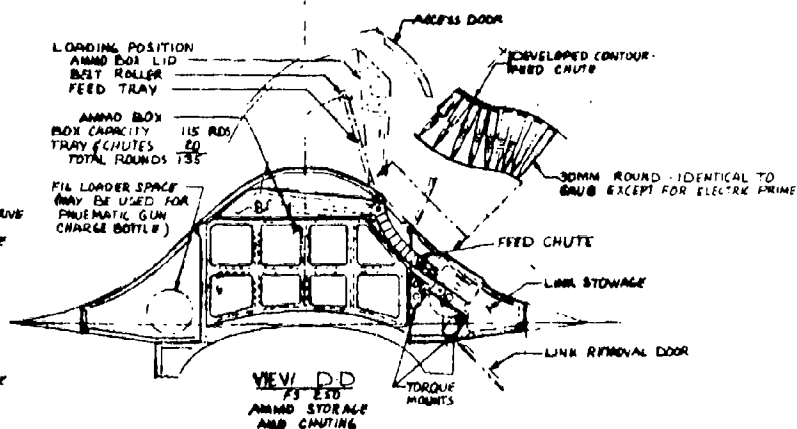
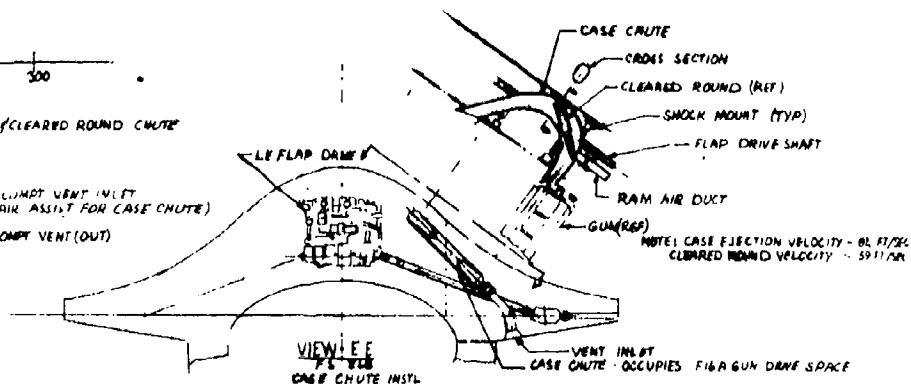
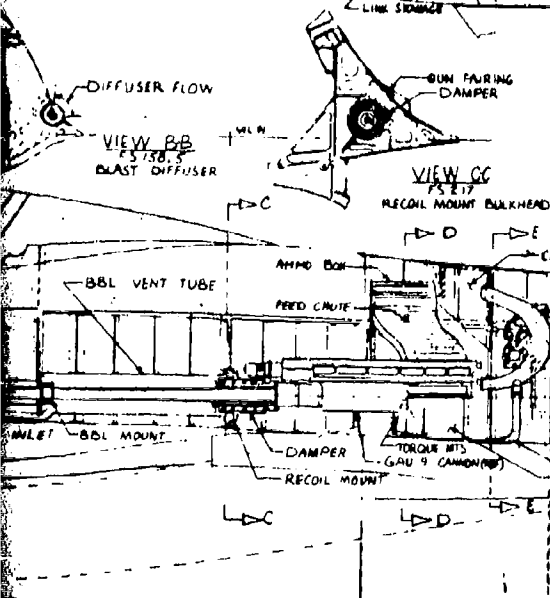
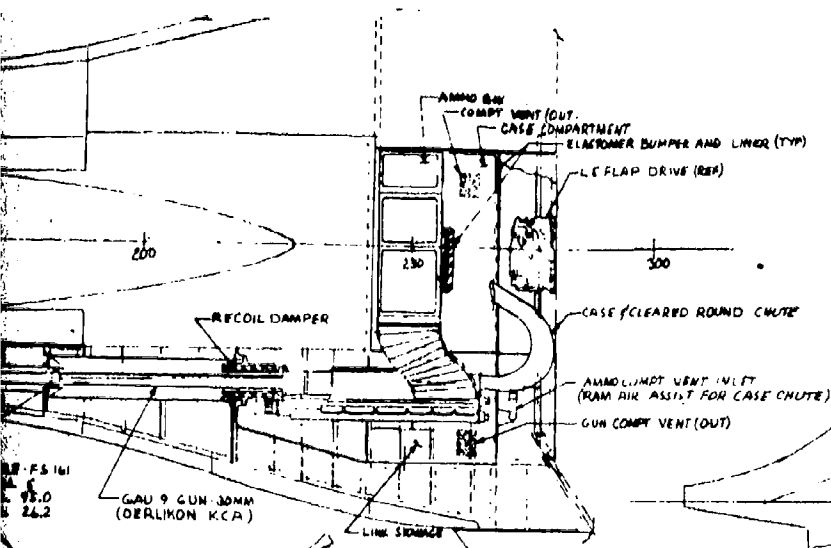


Figure 6
F-16 Internal Oerlikon Mount



2. FOR THIS CONFIGURATION:
A WT. _____ LBS BDW
= _____ LBS GROSS WEIGHT

1 THIS IS CONFIGURATION 23 OF THE
MASTER STUDY CHART
NOTES:

PRELIMINARY DESIGN DRAWING			
STUDY			
30 MM OERLIKON KCA (GAU 9) GUN IN			
LH STRAKE - FIG ADV/ALT GUN STUDY			
DATE	BY	SCALE	UNIT
10/1/58	J. J. JONES	1/4" = 1'	INCH
GENERAL DYNAMICS			FW7606008
Fort Worth Division			POST

Mount

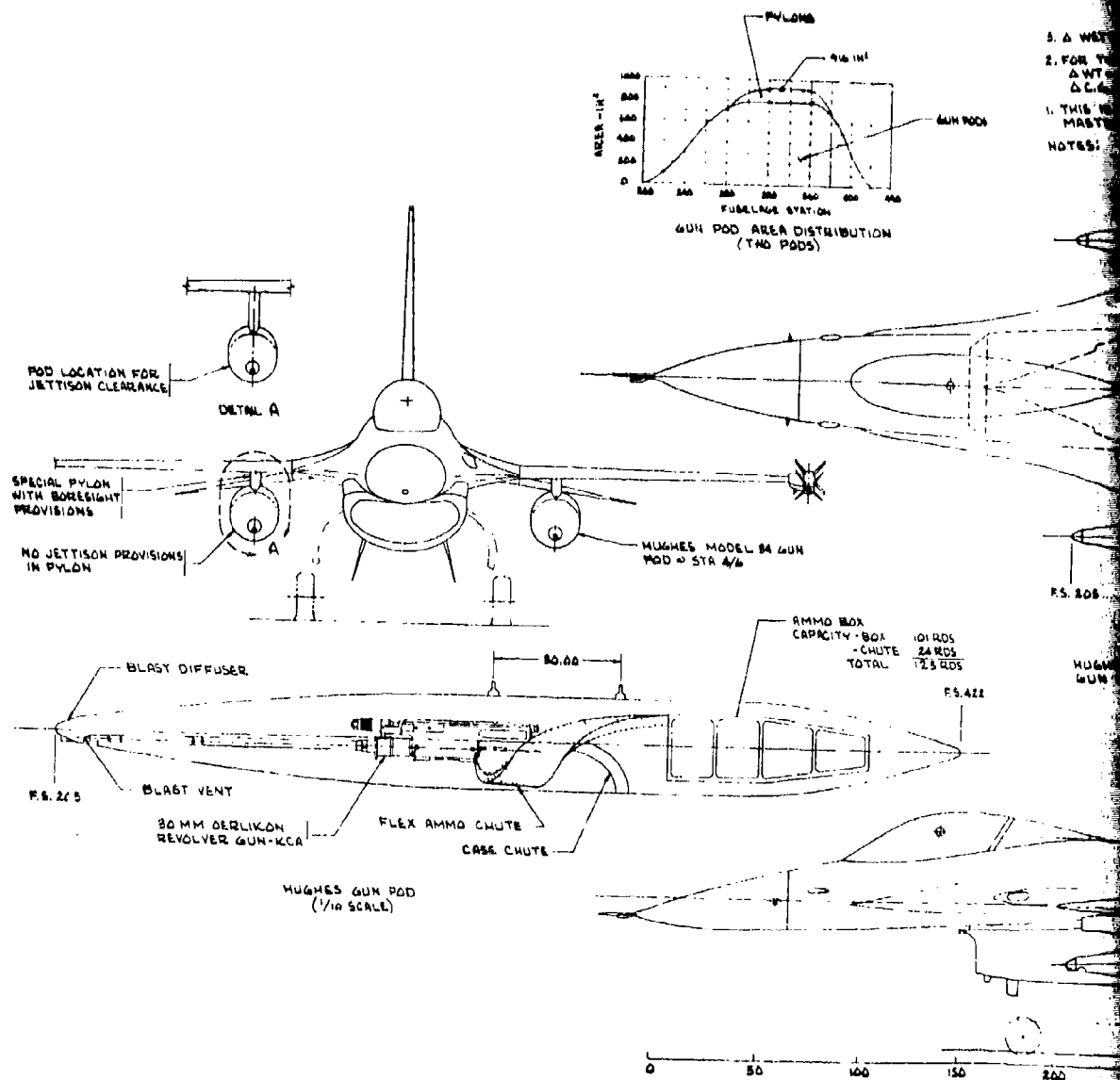
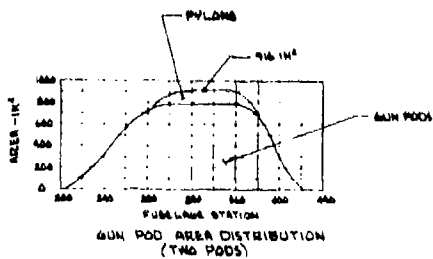


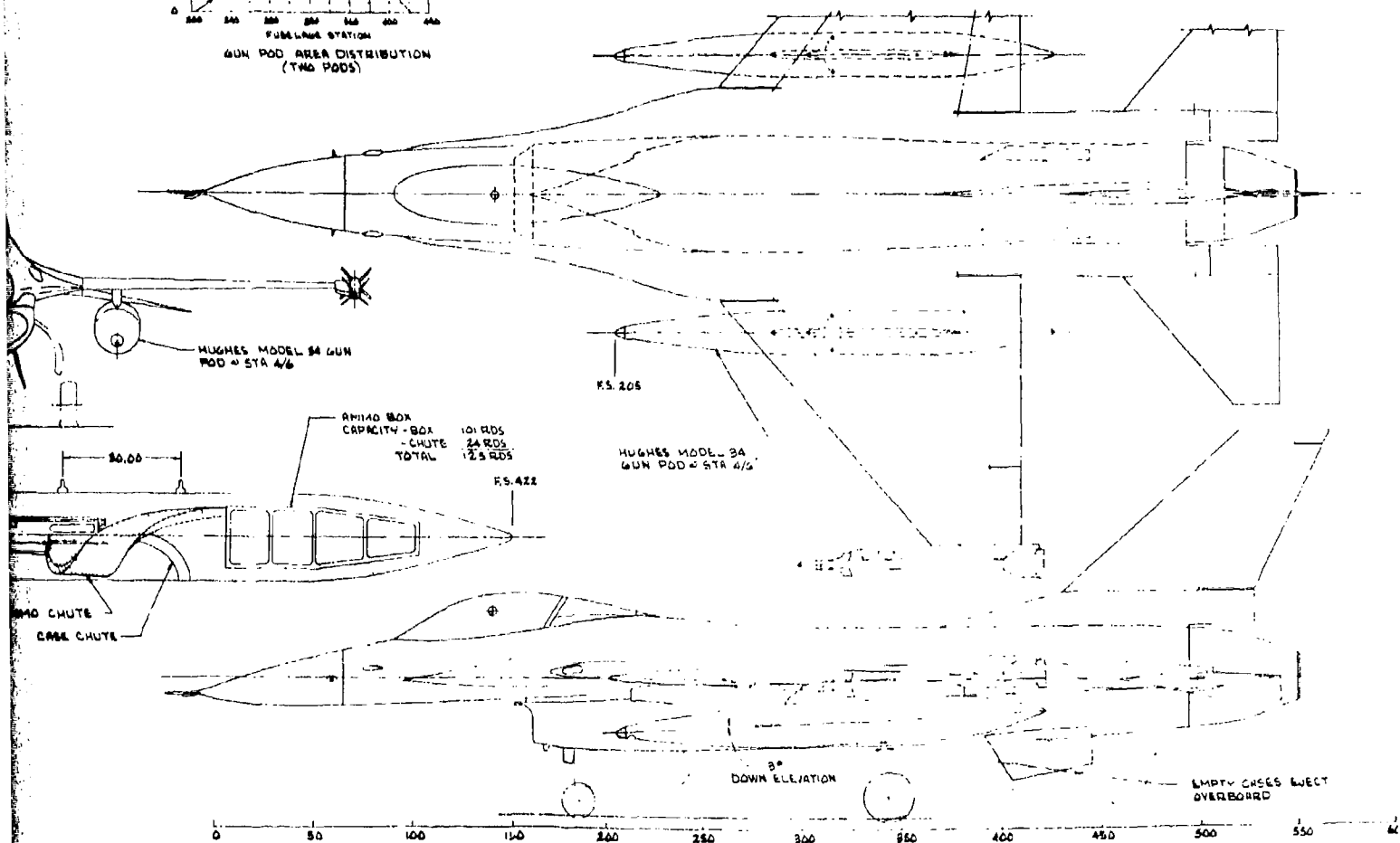
Figure 7
F-16 Oerlikon PODS



3. Δ WETTED AREA = 84.5 FT²/POD
 2. FOR THIS CONFIGURATION:
 Δ WT =
 Δ C.G. =
 1. THIS IS CONFIGURATION 66 OF THE
 MASTER STUDY CHART.
- NOTES:

PRELIMINARY DESIGN DRAWING
 STUDY - DUAL HUGHES MODEL 34 GUN
 PODS (30MM DERLIKON) AT STA 4/6.
 FIG ADVANCED/ALTERNATE GUN STUDY
 GENERAL DYNAMICS FWT 606010
 Fort Worth Division

2



ODS

The primary concern here is the anti-tank capability of the A-7. The LTV Corporation that produces the A-7, completed a USAF directed study concerning the 30mm gun capability of the A-7 considered two types of cannon: the GE GAU 8/A and the Oerlikon 304RK 30mm. Both cannon can use the depleted uranium ammunition fired by the A-10's standard GAU-8 30mm.

LTV study is broken down into two basic sections, internal mounting and external mountings. Internal mounting of the GAU-8 gun is based on single seat production configuration of the two-place A-7E currently being produced for the U.S. Navy. A 30-inch diameter ammo drum and chute system, containing 650 rounds, would be installed behind the cockpit in a manner similar to the standard 20mm drum currently used in the USAF A-7D. Installation of the larger 30mm drum is possible due to the increased length of the fuselage which is retained when the aft cockpit is removed (see Figure 8).

A twin set of Oerlikon 304RK guns can be installed in a standard single-seat A-7D in a manner similar to the twin mounting of the MK 12 20mm guns in the A-7A. and ATB (see Figure 9). A total of 464 rounds of 30mm ammunition is stored aft of the cockpit. This installation requires compartments aft of the speed brake area in order to retain

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GAU-8 gun installation STRETCHED FUSELAGE 650 ROUNDS AMMO

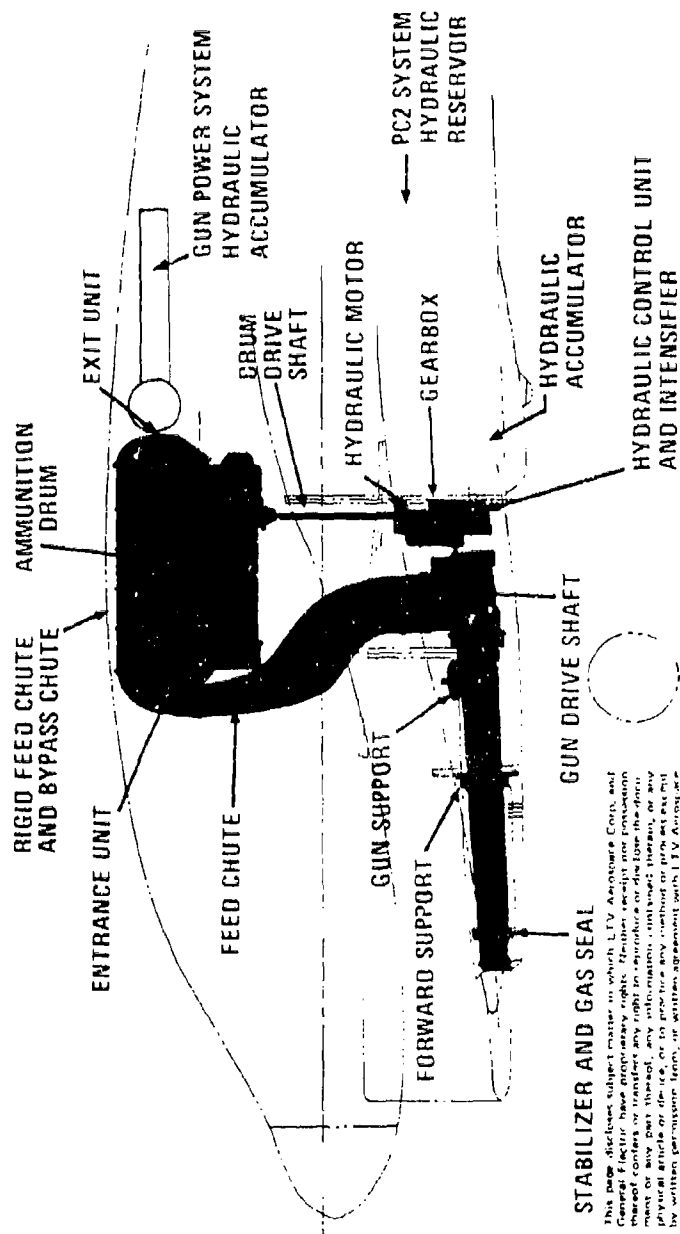


Figure 8
A-7 Internal GAU-8 Cannon.

Twin 30mm Oerlikon gun - fuselage installation in A-7D STANDARD FUSELAGE

484 ROUNDS AMMO

AMMO COMPARTMENT - LH GUN

AMMO COMPARTMENT - RH GUN

REPACKAGED
AIR-CONDITIONING
UNIT

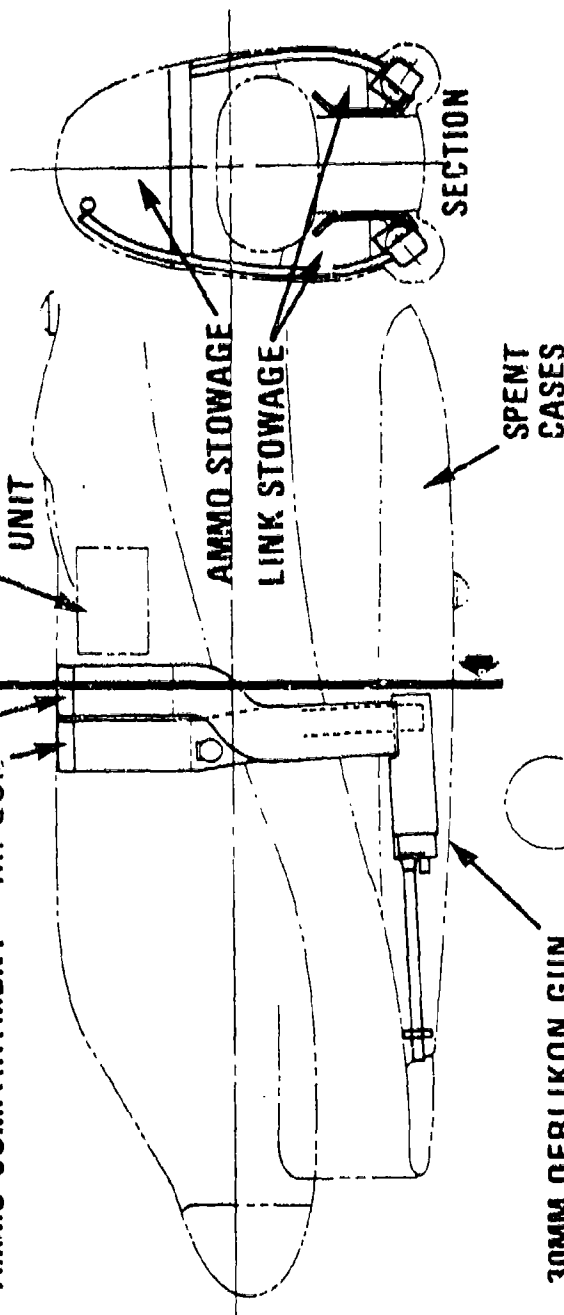


Figure 9
A-7 Oerlikon Twin Internal Mount

spent casings. A comparison of the two internal 30mm mounting options with the current 20mm M61A is shown in Figure 10. The considerations for 30mm the GAU-8/Oerlikon options are displayed in Figure 11.

External options considered by LTV were: GAU-8/A pod, Philco-Ford pod, and Hughes/Oerlikon 304RK gun pod. A typical pod installation is shown in Figure 12. The A-7 experience with the MK4 20mm podded gun has been successful. Downward ejection of spent casings from 20mm pods has caused no damage to the A-7 airframe. The inboard stations of the A-7D/E (stations 3 and 6) are capable of carriage of all the above mentioned 30mm cannon pod systems. No adverse aerodynamics effects or flying qualities are anticipated due to the carriage of the larger 30mm gun pod. If a requirement existed to fire one of the two pods at a time, then a programmed yaw input system would have to be installed in the aircraft.

The A-7 would offer two main advantages as an anti-tank aircraft over the A-10. The A-7 has approximately 50 per cent less plan form area than the A-10, and the A-7 is considerably faster (sea level top speed of 606 KTS versus the A-10's 390). The A-7 has a combat proven, accurate computer ordnance delivery capability. The above mentioned 30mm cannon options can be integrated into the present A-7

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Internal gun system comparison

	GUN		
	30MM GAU 8	30MM OERLIKON	20MM MG1A1
	PROPOSED FOR AX	NOT IN PRODUCTION	A-7, F-104, F-105, F-14, F-111, F-4
MUZZLE VELOCITY	3,500	3,450	3,380
PROJECTILE WEIGHT	5,000	5,000	1,700
ENERGY AT MUZZLE	135,500	133,500	43,000
NO. BARRELS	7	1	6
GUN LENGTH	105	67.8	73.8
CARTRIDGE LENGTH	11.41	11.39	7.2
SYS WT W/O AMMO (ONE GUN)	1,784	358	693
ROUND WEIGHT	2.0 ST 1.5 AL	1.76	0.56
AMMO CONTAINER SIZE VOLUME FOR 1,000 ROUNDS	ROTATING DRUM 34.0 CU FT	COMPARTMENT 33.8 CU FT	ROTATING DRUM 22 DIA x 42 LC 9.25 CU FT
RATE OF FIRE DRIVE SYSTEM	4,000/2,000 HYDRAULIC	1,350 GUN GAS (AIR BOTTLE CHARGED)	6,000/4,000 HYDRAULIC
EFFECT OF DUD ROUND	NONE	GUN STOPS	NONE

Figure 11
A-7 Gun System Comparison GAU-8/Oerlikon/MG1A1

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Typical gun pod installation

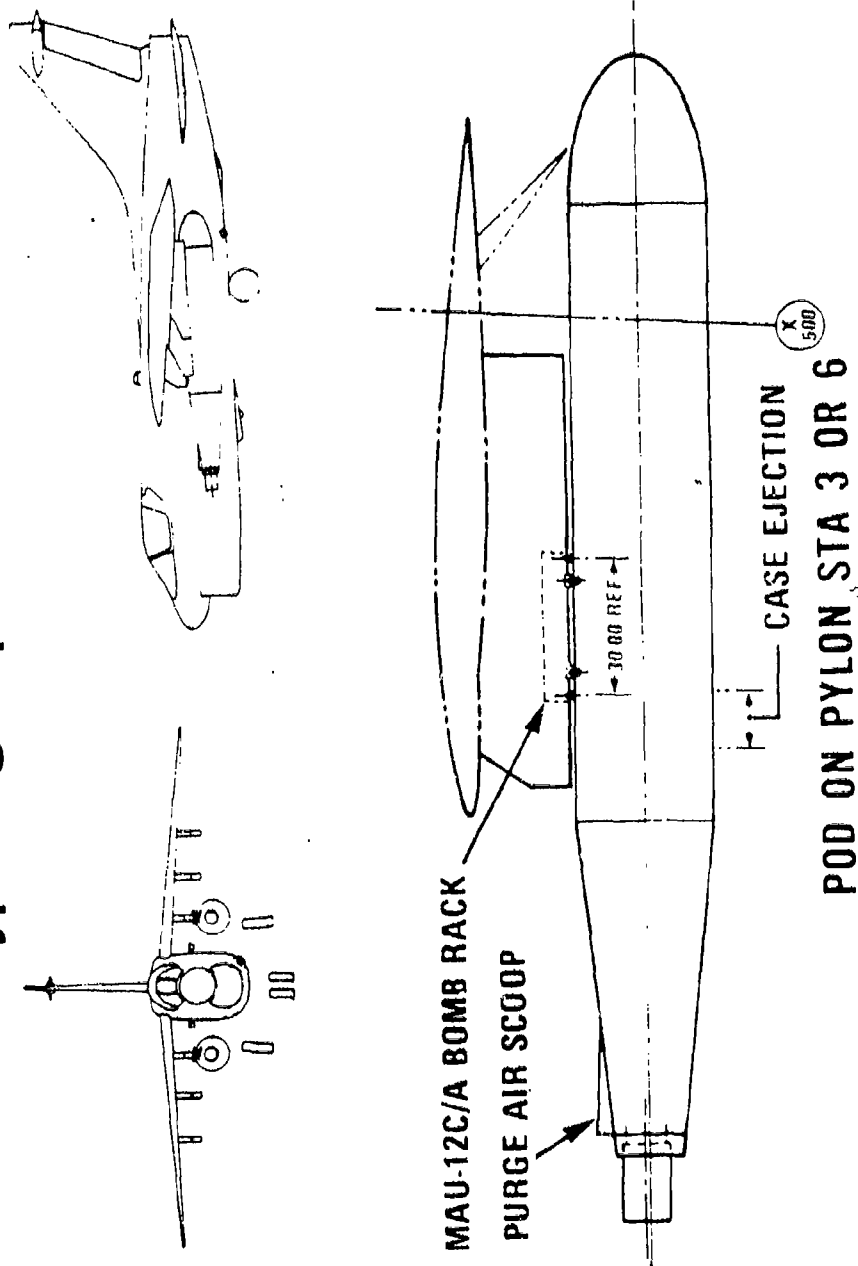


Figure 12
A-7 Typical Gun Pod Installation

computed fire control system. The internal installation of the GE GAU-8 and twin Oerlikon cannons both have a 5.6 mill² continuously computed impact point accuracy. At 2000 feet slant range, this accuracy would equate to 11.2 feet. The pod installations have a considerably degraded capability, only 9.8 mills.³

The LTV study concludes:⁴

1. 30mm guns are compatible with the A-7D, both internal and external installations.
(GAU-8 installation requires fuselage stretch similar to two-place A-7B.)
2. Internal installation provides most accurate system.
3. GAU-8 has higher kill potential.
4. Areas requiring development testing:
 - a) Gun gas effects on engine operation
 - b) Yaw and pitch excursions verifications
 - c) Vibrations effects
 - d) Overall system in-flight reliability.

The A-7 does have several noteworthy disadvantages.

The aircraft is more vulnerable to a fatal AAA hit as it does not have the armour protection advantage of the A-10.

The A-7 has no unimproved field capability and requires

²LTV, Report Number 2-55300/2R-8636, "A-7D 30mm Gun Installation," p. 23, 3 May 1972.

³Ibid., p. 27.

⁴Ibid., p. 31.

generally longer runways for take-off and landing. The A-7 has not been operationally tested with a 30mm gun pod or internal 30mm mounting. The A-7's Allison TF41 FAN engine has not proved to be reliable as other aircraft currently possessed by the USAF. The A-7 does not have the capability to fly as slow as the A-10. This is a vital requirement in searching for camouflaged or hidden armoured vehicles on the ground. Finally, there is the broader implications, within the NATO alliance, of standardizing weapons systems. In this context it is difficult to imagine our European allies purchasing an aircraft that is already 10 years old.

The F-16 is a single seat, single engined, MACH 2 lightweight fighter. Basic performance characteristics are:⁵

Dimensions, External:

Wing span over missile launchers	31 ft 0 in (9.45 m)
Wing span over missiles	32 ft 10 in (10.01 m)
Wing aspect ratio	3.0
Length overall, excl probe:	
YF-16	46 ft 6 in (14.175 m)
F-16A/B	47 ft 7.7 in (14.52 m)
Height overall:	
YF-16	16 ft 3 in (4.95 m)
F-16A/B	16 ft 5.2 in (5.01 m)
Tailplane span	18 ft 0.34 in (5.495 m)
Wheel track	7 ft 9 in (2.36 m)
Wheelbase	13 ft 1.52 in (4.00 m)

⁵Jane's All the World's Aircraft, p. 343, Jane's Year-books, 1975.

Areas:

Wings, gross:

YF-16	280.0 sq ft (26.01 m ²)
F-16A/B	300.0 sq ft (27.87 m ²)

Weights and Loadings (F-16A):

Operational empty weight

approx 14,060 lb (6,377 kg)

Max external load 15,200 lb (6,894 kg)

Structural design gross weight (7.33g) with full
internal fuel 22,500 lb (10,205 kg)

Max T-O weight:

YF-16, max weight at which flown
27,000 lb (12,247 kg)

F-16A with max external load
33,000 lb (14,968 kg)

Wing loading:

at 22,000 lb (10,070 kg) AUW
74 lb/sq ft (361 kg/m²)

at 33,000 lb (14,968 kg) AUW
110 lb/sq ft (537 kg/m²)

Thrust/weight ratio (clean) 1.1 to 1

Performance (YF-16, as assessed in NATO Steering
Committee report, March 1975):

T-O weight, clean, with 2 Sidewinders
21,600 lb (9,797 kg)

External load with max internal fuel
11,500 lb (5,216 kg)

Thrust/weight ratio at 21,600 lb (9,797 kg)
1.1 to 1

Max level speed at 36,000 ft (11,000 m) with 2
Sidewinders Mach 1.95

Max rate of climb in 5g turn at low level at
Mach 0.7, with 6 MK 82 bombs
42,000 ft (12,802 m)/min

Sustained turn rate at 20,000 ft (6,100 m) with
max internal fuel and 2 Sidewinders
10.7°/sec.

Sustained air turning radius at low level at Mach 0.7
with 6 MK 82 bombs, 4,500 ft (1,372 m)

T-O run with 4,000 lb (1,814 kg) external load
1,750 ft (533 m)

Landing run with 4,000 lb (1,814 kg) external load
2,650 ft (808 m)

Radius of action with 6 MK 82 bombs
295 nm (340 miles; 547 km).

A look at the dimensions of the aircraft (see Figure 13) reveals that the F-16 is considerably smaller than the tactical aircraft currently possessed by the USAF.

The F-16 can carry the GE GAU-8/A 30mm gun on the inboard wing station if it is counter balanced by a fuel tank on the opposite wing. The adverse yaw while firing and the asymmetrical characteristics of carrying dissimilar loads on opposite wings, make this option impracticable. The other pod 30mm (D.U. capable) cannon considered by General Dynamics for the F-16 is the Oerlikon/Hughes model 34 pod. This cannon is essentially the same one described above for use in the A-7. The Hughes model 34 pod is mounted on stations 4 and 6 of the F-16 (see Figure 6) and each pod carried a total of 125 rounds.

Internal 30mm options for the F-16 are limited to the Oerlikon KCA. This is basically the same revolver cannon used for the model 34 pod. The Oerlikon KCA internal mounting carries a total of 135 30mm rounds. (See Figure 5.) Accuracies are not available as of this writing, however they can be expected to be on the order of those accuracies listed for the A-7 internal and 30mm versions.

The F-16 has basically the same advantages of the A-7; higher speed, and smaller plan form. The F-16 is also well on the way to becoming the standard NATO fighter of the

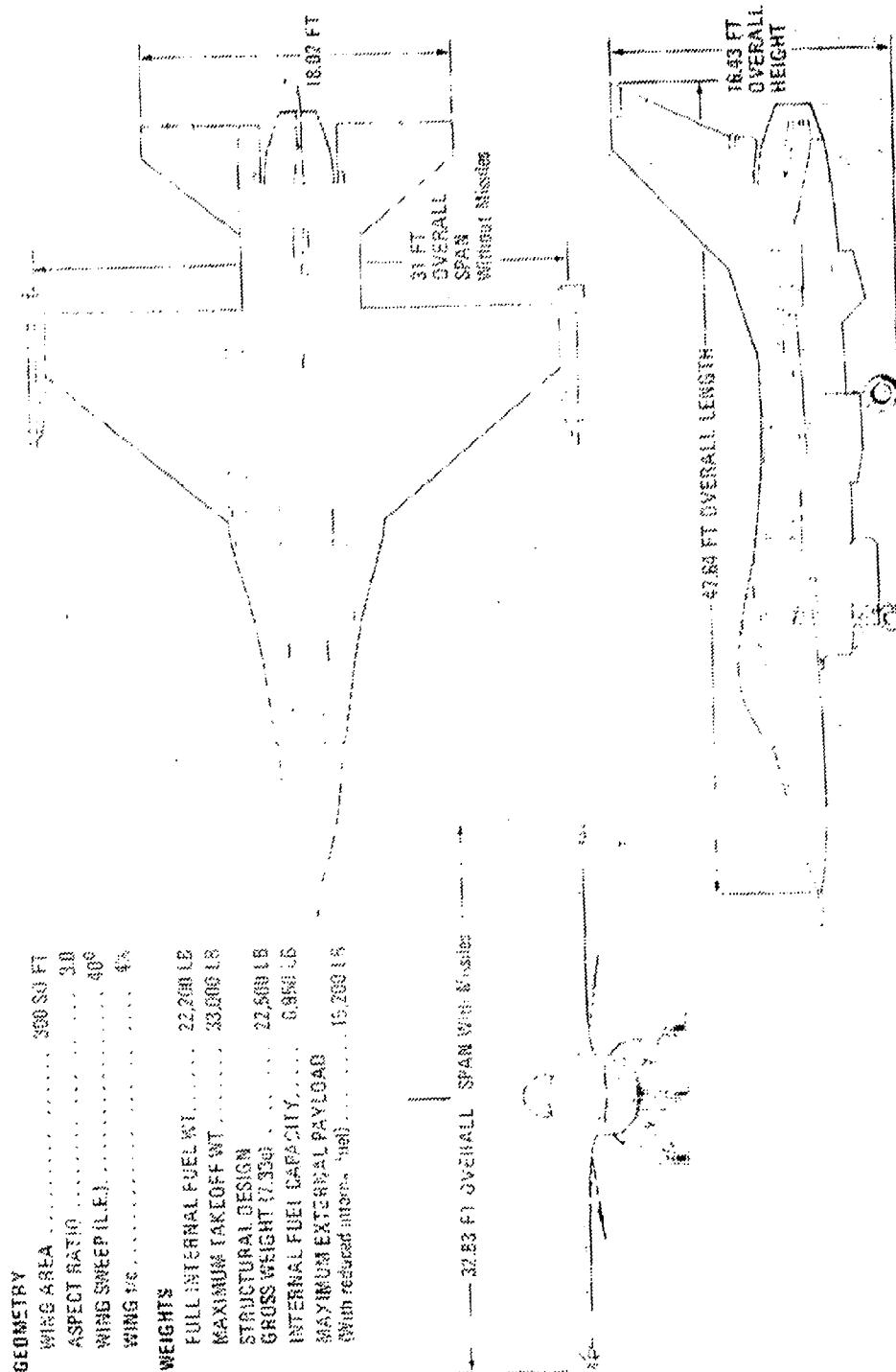


Figure 13
F-16 Dimensions

future. It is also a multi-mission aircraft with air-to-air, air-to-ground and close-air support capability.

The F-16 disadvantages stem from its being a new weapons system. It is not operationally, or combat proven. One can assume that the F-16 will have a capability to destroy enemy armoured vehicles - as the Oerlikon 30mm round is essentially the same as the GAU-8 30mm round, however, it has yet to be operationally tested. The F-16 does not have the capability to fly slow enough to be able to detect hidden and camouflaged enemy armoured vehicles. The F-16 also does not have any unimproved air field capability.

CHAPTER VIII

A Meeting with Oberst Rudel

In conjunction with research for this thesis, the author determined that it would be necessary to travel to the Federal Republic of Germany (hereafter referred to as FRG) and investigate first-hand sources there. The principle objective was the Bundesarchiv-Militärarchiv located at Freiburg im Breisgau, West Germany. Through the good offices of Dr. Horst Boog of the Militärgeschichtliches Forschungsamt, also located in Freiburg, the author was able to obtain the address of Brigadegeneral a.D. Paul-Werner Hozzel, who had been a prominent Stuka pilot during World War Two. Correspondence with General Hozzel was most encouraging and the author was able to obtain an interview with the General at his office in Karlsruhe, FRG.

Prior to departing for Europe in June 1976, the author was determined to locate Oberst Rudel. However, the only information available on Rudel was that he had been living in Kufstein, Austria in 1970. In spite of such scant information, Oberst Rudel was deemed so important, for his military knowledge and experience, that the author was willing to go to any extreme to locate the famous "tank killer."

The author arrived in the FRG at Frankfurt am Main airport on a Friday. The entire weekend was free as the Bundesarchiv-Militärarchiv is opened only during weekdays. The author elected to go to Kufstein, Austria and see if Rudel could be located. Oberst Rudel does, in fact, reside in Kufstein, but when the author arrived and inquired as to Herr Rudel's whereabouts, his housekeeper informed the author that Rudel was in Chicago, Illinois, for medical treatment related to a stroke that he had suffered in 1969.

The housekeeper was kind enough to give the author the address in Chicago where Oberst Rudel was staying during his medical treatment. Returning to the United States, the author went directly to Chicago and was able to contact Rudel and arrange an interview, which took place on 28 June 1976. (see Appendix XI).

Subsequent to this interview with Oberst Rudel, the author determined that the Fairchild-Hiller Corporation and the USAF were interested in meeting Rudel for purposes of exploiting his knowledge of anti-tank air operations and experience on the German Eastern Front during the Second World War.

The author was able to relay an invitation on behalf of the Fairchild-Hiller Corporation to Oberst Rudel to attend, as the main speaker, an aircraft anti-tank seminar to be

held in Washington D. C. on 14-15 October 1976. The author accompanied Oberst Rudel to the seminar and made some of the arrangements for his visit.

The author met Oberst Rudel, again in Chicago, on Sunday 10 October 1976 and remained with him until the following Saturday (16 October) when Rudel departed for the FRG. In the course of this week with the foremost tank hunter and especially the very productive seminar on 14 and 15 October, several important, heretofore unstudied, facts emerged.

The salient points include the following:

1. The ratio of anti-tank aircraft lost versus tanks destroyed was approximately 1:20.
2. The ratio of anti-tank pilots lost versus tanks destroyed was approximately 1:40.
3. Absolute weather minimums for JU87G Stuka employment were 30 meters (100 feet) ceiling and 3 kilometers visibility.
4. Enemy and friendly ground positions were often so fluid and intertwined that Oberst Rudel was only able to identify friendly ground troops by making an extremely low pass (5-10 meters) above the ground and look for the distinctive silhouette of the German helmet.
5. Approximately one half of the Schlachtflieger who were shot down were recovered by friendly forces.
6. Schlachtflieger on the Eastern Front could expect 6-7 days off each year.
7. Oberst Rudel considered the backseater of the Stuka as a vital component of the capability of the anti-tank aircraft as it allowed the pilot to give his undivided attention to searching for concealed

enemy tanks, while the backseater was looking for enemy aircraft or other distractions.

8. For a pilot to record a tank as "killed" he had to fulfill three requirements:
- a. The tank had to explode internally.
 - b. The tank had to burn.
 - c. The tank in question had to be observed by another party, other than the pilot making the claim.

9. Oberst Rudel estimates his de facto score of tanks destroyed as approximately three times the de Jure figure of 519.

10. Rudel considers the single most important factor in his success, and that of the Schlachtflieger as a whole, was der Geist, or spirit. That quality of will power or esprit de corps which motivated men beyond their normal means.

11. Rudel does not feel that he could have survived the war, were it not for his attention to his physical conditioning, which was practiced on a daily basis. (He would jog 10 kilometers each day.)

What sort of man is Rudel? What are the characteristics that make a man capable of achieving his magnitude of accomplishment? Basic facts can explain a lot of Rudel's character. He was promoted to Oberst at the age of 28 and simultaneously awarded the Golden Oakleaf with Swords and Diamonds to the Knight's Cross of the Iron Cross,^{1*} (this was Germany's highest decoration in World War Two, only one

*"Das Goldene Eichenlaub mit Schwertern und Brillanten zum Ritterkreuz des Eiserner Kreuzes."

¹Just, Gunther, Stuka-Oberst, p. 43, Motorbuch Verlag, 1975.

of which was minted--for Oberst Rudel alone, see Appendix VIII). He sank the Russian battleship Murat, with one bomb that had the good fortune of hitting the ship's main munitions storage area. After being downed behind enemy lines and captured by the Russians, Rudel escaped and in the process was wounded by rifle fire. In spite of serious loss of blood he traveled, on foot, 60 kilometers during the course of one night--evading Russian formations--without any heavy clothing or shoes, finally arriving back to German held territory. An objective analysis of Rudel also reveals:

1. Experience as Staffelkapitän, Gruppenkomodeur, and Geschwaderkommandore.
2. Very traditional and solid middle class background.
3. Best-selling author.
4. 2530 combat sorties.
5. Shot down--by ground fire--over 30 times.
6. Scored 11 air-to-air kills.
7. A non-drinker and non-smoker.
8. Expert pilot, but slow learner.*
9. A deeply religious man.

Subjectively Oberst Rudel is not the sort of man whom one would suspect had accomplished so much and received

*See Stuka Pilot, a little reading between the lines on chapter concerning training will confirm Rudel's slow learning.

such tremendous notoriety. He is a warm and gregarious person. One is almost infected with his dynamism, even after a very serious stroke, which left his right side paralyzed, Oberst Rudel walks three full hours every day and swims for an hour when facilities are available. He is a man of extreme will power and resolution. He is a firm believer in the values of Western Civilization and has an undying animosity toward Bolshevism.

If NATO pilots were all duplicates of Oberst Rudel, then NATO's air forces could probably destroy any Warsaw Pact invasion of Western Europe by airpower alone. NATO's pilots are not Rudels, but by identifying the factors that made Oberst Rudel such a successful pilot, one can hope to develop such factors in the pilots that are being trained for possible combat operations in Europe.

Above all Rudel was an unusually aggressive pilot. He even considers it a miracle that he was able to survive the war. A closer look at Rudel will indicate that while he was very aggressive, his real motivation was an undying belief in the righteousness of his cause and an unshakable empathy with the soldier on the ground. The aggressive attitude, belief in a cause and feeling of comradeship can all be summed up in one word: der Geist.

Oberst Rudel, in his closing remarks to the anti-tank seminar made the importance of Geist very clear. He said that the new A-10 aircraft with the 30mm GAU 8 cannon was a giant step in the right direction toward neutralizing the Russian threat to Western Europe, but without the quality of Geist to motivate the troops, it would all come to naught. How commanders can inject the quality of Geist into the soldiers of NATO is beyond the scope of this thesis, it is mentioned only to illustrate that technology does not win wars alone--NO GEIST, NO VICTORY.

CHAPTER IX

Conclusions

The anti-tank options available to the USAF today, i.e., operationally ready deployed tactical fighter units, are nil. Although all tactical aircraft in the USAF inventory could be equipped with Rockeye-type cluster bomblettes, it has been historically demonstrated that this type of munitions has limited utility considering possible employment situations. The main problem, with cluster munitions as well as a variety of "smart bombs," is that of weather. The limiting effect of weather in Europe on flying operations is great; there are simply too many days on which tactical airpower would be useless if the weapons loads consisted of only "smart bombs" or cluster type bombs. The pilots of the aircraft would not be able to achieve the release parameters required of such munitions assuming of course that they were able to find enemy armoured formations in the first place.

On the other hand, 30mm cannon equipped tactical aircraft are in many cases already below the weather, because the optimum effective slant range for employment of the 30mm cannon is approximately in the 4000 foot range. For

an immediate increase in the capability of USAF tactical units in Europe, one solution would be the equipping of fighter aircraft with a 30mm gun pod. The General Electric GAU-8/A and the Hughes-Oerlikon model 34 pod would appear to be the best options of those which are presently available (See Appendix XII). The near future for tank hunting appears to be considerably brighter with the introduction of the A-10 with its 30mm gun into the operational inventory; and the following conclusions will deal largely with employment of the A-10 weapons system.

As the A-10 is, in many respects, a completely new type of aircraft for the USAF with unique capabilities and characteristics, a new conceptual doctrine of employment must be developed to exploit the vast potential of this new weapons system. Essentially the A-10 will be used as an airborne platform to aid ground forces in Europe in combating the huge disparity between NATO and Warsaw Pact forces, especially in tanks, (See Introduction).

The A-10 is a new type of weapons system for the USAF, however, the historically preceding weapon JU87G and HS129 of World War Two can be instructively studied and, indeed, the basic analogy between the JU87G/T-34 and the A-10/T-62 does seem to have much validity. The relative cost figures tank reverse aircraft, have changed considerably; for example,

the A-10 aircraft is relatively much more expensive than the current Soviet MBT, T-62. The basic confrontation of forces and probable kill ratios in favor of aircraft appear to hold when comparing available data from World War Two with projected kill ratio today. It is particularly important to emphasize that while the USAF combat experience with anti-tank cannon aircraft is presently nonexistent, there is still a tremendous core of experience in the form of the Luftwaffe personnel who operated on the Eastern Front in World War Two. The Luftwaffe case indicated the need for:

1. Forward basing of aircraft assets.
2. Capability for rapid generation of sorties.
3. Close coordination and identification with friendly ground troops.

Forward basing is necessary in order to achieve the minimum time between the call for, and the actual employment of, air support. Airpower offers the most effective means of rapidly concentrating firepower on an armoured breakthrough where ground forces are not strong enough to counter the enemy formations. As such, every minute is vital and the only way to close potential gaps is to have aircraft close to the front line ground units.

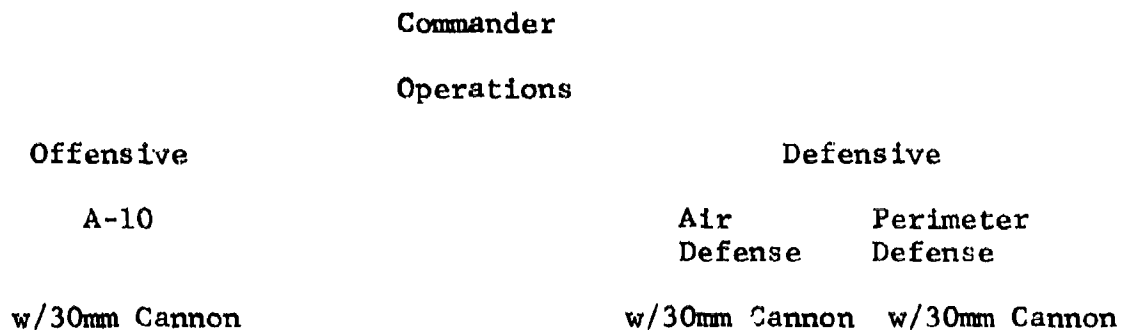
NATO does not possess unlimited air resources, and the most efficient and effective use of available assets is

necessary. In some important ways the number of aircraft possessed is irrelevant; what is important is how many sorties can be generated and how quickly. For example a squadron with 10 aircraft that can each fly 5 times a day, is more effective than a squadron with 20 aircraft which only fly twice a day. The same line of reasoning is true of pilots. The sortie generation rate is also important in keeping pressure on the enemy tank force and precluding its disengagement as illustrated in the "Meyer Model" (see Chapter IV).

The close coordination and identification with ground forces is especially important. Never before has the success of an airborne weapons system depended so much on the actual support it can give to friendly ground troops. A human link is necessary to provide the required liaison with the ground commander and to direct in some cases the actual fire support that is delivered by the aircraft. The liaison officer must be well versed in the operational concepts and capabilities of the air and ground forces in which he serves as a vital component.

The tank hunting squadrons can be thought of as units built around a weapon rather than a weapons platform. The weapon is the high velocity, rapid fire 30mm cannon. The individual commander, for example, of a squadron-sized self

contained organization would be a leader in the offensive sense and also, in light of the need to protect his mobile airfield perimeter, a defensive sense. The squadron-sized unit is an instructive one to consider because of its relatively high mobility, ease of dispersal, and optimum offensive capability, as a function of command and closeness of unit personnel. A rough mission-oriented organization chart would appear as follows:



The commander in the above model is responsible for conducting tank hunting operations under the command of a regional over-all Air Forces commander and working in close coordination with the local ground forces commander. The commander is also responsible to a degree for his own anti-aircraft on ground perimeter defense.

The commander's responsibilities are somewhat simplified because the powerful 30mm General Electric and Oerlikon type 30mm cannons can destroy most armoured vehicles from the

ground. The cannon has, furthermore, the potential for being an excellent anti-aircraft system. With the optimization of personnel resources as a prime goal within NATO, using personnel for occasional duty as AA gunners or perimeter defense has the advantage of releasing ground units for offensive employment against the enemy.

By using the same weapons for perimeter defense, anti-aircraft defense, and offensive air operations, the logistics and the weapons maintenance systems are simplified, and personnel are utilized in a more efficient manner. The commander's primary responsibility is, of course, offensive air operations in support of friendly ground units, but in order to conduct offensive operations he must be able to secure his operating base and generate a maximum number of sorties. Basing the air assets far to the rear in large concentrations presents a tempting target for the enemy, it places the air support further away from the front lines where it is needed, and moves the air commander too far away from the ground commander, physically and empathetically, whom he is supposed to support.

The A-10 platform can be expected to operate offensively in three basic roles:

1. The "Meyer Model" (see Chapter IV)
2. Interdiction

3. Close-Air-Support

In the "Meyer Model," the aircraft would be operating independently in a tank hunter strike mode, whereby the aircraft would seek out and then destroy enemy armoured forces.

Interdiction would involve air strikes at pre-designated areas where enemy armoured forces were determined to be located. Close-air-support, finally, would involve the support of ground units, in defensive or offensive postures, which had encountered enemy opposition which required heavy fire power.

Tactics for the type of mission envisaged for the A-10 have to be built around an optimum slant range of 4000 feet for the 30mm GAU-8 cannon. The relatively close slant range first of all, puts the attacking aircraft with the range of just about every anti-aircraft weapons system possessed by the enemy. However the situation is not so bleak as it initially appears. Because the A-10 must operate close to the ground, it has several advantages: terrain masking from threat radars, exposure to limited observation (the aircraft can only be seen from the immediate area over which it is flying), and within easy reach at the low altitude blind areas of many surface-to-air missiles systems (it is difficult to track an aircraft on radar at treetop level).

Especially important is the fact that all the assets that

the enemy puts into SAM systems and sophisticated radar warnings are assets that he takes away from conventional AAA defense with probable significant increase in the survivability of the A-10 because the main threat, with which the A-10 is concerned, is barrage AAA fire.

In order to detect concealed enemy tanks, the A-10, in some tactical situations will have to fly slowly so that the pilot will be able to spot the tanks on the ground. The slow speed requirement is a case of the pilots having to "bite the bullet." There is no way to discover a well hidden enemy by flying over him at supersonic speeds. A pilot becomes a fighting man similar to the basic infantryman whom he supports. The USAF cannot hope to make its presence felt unless it is willing to employ its pilots in a manner where they can bring pressure to bear on the enemy, and in the context of the A-10, this pressure requires an aggressive willingness to seek out and destroy the enemy on the ground.

Once the enemy is discovered, it is absolutely critical that he not be allowed to escape. If the Air Force is to do its job in Europe relative to anti-tank defense, the enemy armour must be destroyed, preferably before it has the chance to come into contact with friendly ground forces. Once discovered by air a constant pressure must be kept up

on the enemy until his armoured formations are destroyed. The enemy must not be given a chance to regroup, disengage, or seek cover; he must be ruthlessly destroyed.

The Warsaw Pact ground forces have shortcomings relative to their logistics support. The ZSU 23/4, for example, carries only a 65 rounds per magazine for each barrel and therefore "the 23/4 can fire but three short bursts against an incoming target and possibly one more as it recedes."¹ This is one example which supports the point that NATO air forces, to be used at the optimum level, must keep constant pressure on the enemy, once he has executed his initial push and expended or substantially reduced his first issue of ammunition. A corollary would be that NATO commanders must not get "cold feet" after the first rather heavy losses encountered by friendly air units, for if the initial losses are to be made good, the follow-on sorties must be made in order to take advantage of reduced air defense strength and exposure of the armoured formations to close range attack with guns.

Preparation for the future deployment of an aircraft anti-tank package involves a tremendous effort in the area of training. The primary human resource is, of course, the

¹International Defense Review, Op. Cit., p. 182.

pilots who will be flying the A-10 and subsequent models of aircraft in combat. The training of the pilots is of the utmost importance if the weapons system is to be effectively and efficiently employed. The future anti-tank pilot must have complete knowledge of his weapons system, its advantages, disadvantages, capabilities and shortcomings. He must also have a basic understanding of, and empathy for, the ground troops, whom he is supporting. Thorough indoctrination in Army ground tactics and command and control systems is mandatory. As opposed to USAF experience in the past, the anti-tank pilot of the future will be working in close coordination with friendly ground units and close-in among the enemy armoured attacking forces. If the friendly ground and air forces cannot communicate and work in close harmony with each other, the combat potential may not be up to the task of successful defense and counter-attack in Europe.

Because NATO is outnumbered by the Warsaw Pact forces, NATO must do more with less. It is imperative, therefore, that the limited personnel resources be utilized to the maximum extent possible. One suggestion would be to cross-train a squadron's maintenance and ground support personnel, as well as pilots to serve as the AAA and perimeter defense forces for the squadron's airfield. The point has already

been made that the 30mm cannon can be used defensively as well as offensively. Why not use the integral squadron personnel for tasks other than those associated with the actual flying operation? The mission of the flying unit is keeping the aircraft in the air engaged with the enemy, part of this function is having a secure base from which to operate. There is no reason why the associated squadron personnel cannot fulfill this defensive function--or at least augment forces detailed for those functions.

The commander has the key task of tying the whole operation together. To make his organization, effective mobile and self sufficient as possible, he must be intimately familiar with all aspects of his squadron, both flying and non-flying. Above all he must demonstrate the flexibility to get the job done. He must innovatively seek to have his aircraft on target and ready to fight, when and where they are required and in sufficient numbers to successfully counter the enemy opposition.

Mobility is a key to bringing about a concentration of fire power, at the right time and place to effect the favorable outcome of a battle. Flying anti-tank units must therefore be as self-contained as possible, in order to be able to concentrate their fire power. The aircraft alone cannot be mobile, the entire organization must be able to

pack up and relocate within a minimum amount of time. Standardization of defensive and offensive weapons aids this mobility as well as a basic simplification of systems so that they can be kept in good working order with a minimum amount of service.

Simple, rugged, easy to maintain systems, that can be serviced under the most severe field conditions are keys to mobility. A minimum amount of AGE (Aerospace Ground Equipment) that can be packed, unpacked and ready to operate also aids the unit's mobility. Finally to move a unit intra-theatre, due to a fluid battlefield situation, as much of the units transport as possible should be organic to the unit--within the constraints of cost of course. One option, that has to date not been exploited, is the possible use of glider aircraft to aid in the logistics needs of the unit. All AGE and personnel belonging to the unit could be transported by glider which in turn would be towed by A-10 aircraft during deployment. During the employment phase, gliders could be used to augment the normal logistics requirements of the unit.

Standardization within the flying unit has already been discussed. In the broader context, standardization within NATO would greatly increase the effectiveness of forces. The goal would be to make the A-10, or its successor, the

standard anti-tank/close-air-support aircraft for all NATO air forces. This would, however, require a quid pro quo arrangement. From the U.S. viewpoint, standardization within NATO cannot be a one way street. As defense costs are borne by all NATO allies, the U.S. cannot expect all of the defense outlays to eventually wind up in the U.S. If a U.S. aircraft is to be the standard, then the U.S. must consent to having production rights given to NATO allies, or at a minimum having component parts produced in NATO countries. The U.S. cannot hope to produce an atmosphere of collective defense of Europe by dictating to loyal allies.

There are factors in the A-10 which make it less of an anti-tank aircraft than what it could have been. Hindsight, of course, is particularly clear, but learning from the past must be pursued. The U.S. Government has committed approximately \$4 billion dollars on the production and procurement of the A-10, primarily to be able to provide close-air-support and kill tanks from the air. Yet, until this thesis was begun no one had taken it upon himself to consult with Oberst Rudel, who is the most experienced anti-tank pilot in the world. Other lessons can be learned from history and our contemporary NATO allies. Fostering a spirit of mutual cooperation and trust can only work to the establishment of a beneficial and mutually profitable relationship on both sides of the Atlantic.

APPENDIX I

List of equivalent Luftwaffe officer ranks.*

<u>Luftwaffe</u>	<u>Royal Air Force</u>	<u>US Air Force</u>
Leutnant	Pilot Officer	Second Lieutenant
Oberleutnant	Flying Officer	First Lieutenant
Hauptmann	Flight Lieutenant	Captain
Major	Squadron Leader	Major
Oberstleutnant	Wing Commander	Lieutenant Colonel
Oberst	Group Captain	Colonel
Generalmajor	Air Commodore	Brigadier General
Generalleutnant	Air Vice Marshall	Major General
General der Flieger (der Flak, etc.)	Air Marshall	Lieutenant General
Generaloberst	Air Chief Marshall	General
Generalfeldmarschall	Marshall of the Royal Air Force	General of the Air Force
Reichsmarschall des Grossdeutschen Reiches ⁺		

*The equivalent ranks for General Officers apply only to World War II. The new German Air Force follows the American pattern; for example a Major General in the new GAF is called a Generalmajor, a Lieutenant General is a Generalleutnant.

⁺One only, the rank held by Hermann Goering alone.

APPENDIX II

Oberkommando der Wehrmacht

Oberkommando der Luftwaffe

- | | | | | |
|----|-----------------|------------|-----------------|----------------------|
| 1. | Luftflotte | Luftflotte | Luftflotte | Luftflotte |
| 2. | Fliegerdivision | | Fliegerdivision | |
| 3. | Geschwader | Geschwader | Geschwader | |
| 4. | Stab | I Gruppe | II Gruppe | III Gruppe IV Gruppe |
| 5. | Stab | 1 Staffel | 2 Staffel | 3 Staffel 4 Staffel |
| 6. | Schwarm | Schwarm | Schwarm | Schwarm |
| 7. | Rotta | Rotta | Rotta | Rotta |

Key:

1. Luftflotten were organized on a geographical basis. They contained all types of aircraft (fighters, bombers, transport, etc.). Depending on the theatre, strength could vary from 200 to 1300 aircraft.

2. A Fliegerdivision, later Fliegerkorps, could operate separately or under a Luftflotte. A Fliegerdivision had all types of aircraft and strength varied from 200 to 750 aircraft.

3. The Geschwader was the largest formation with a set strength, normally 150 aircraft; organized into 3 Gruppen with a Stabgruppe consisting of 4 aircraft. A Geschwader would be organized around a particular mission, but not necessarily have all the same kind of aircraft, for example a Schlachtgeschwader might have Gruppen of HS129s, JU87Gs and FW190s. The name of the Geschwader would indicate its mission: e.g. Jadgeschwader for air superiority.

4. A Gruppe had nominally 50 aircraft organized into 3 Staffeln and a Stabstaffel with 3 aircraft. A IV Gruppe

was added to some Geschwader as a field testing unit, or examining new equipment in combat, or training. Later some Schlachtgeschwader formed the IV Gruppe into a tank destroying Gruppe. A Gruppe would contain only one type of aircraft, under normal circumstances.

5. A Staffel usually had from 9 to 16 aircraft. 3 to 4 Staffeln made up a Gruppe.

6. A Schwarm or Kette (used for fighters only) has 4 or 3 aircraft. A Schwarm was the basic in-flight combat formation, roughly equivalent to a USAF flight.

7. Rotta was the smallest Luftwaffe unit consisting of a 2 or 3 aircraft formation.

APPENDIX III

Penetration Performance of Tugnsten-Carbide Ammunition

Weapon	Aircraft	Slant Range at Firing-meters	Angle of Impact	Penetration Capability-mm
MK 103 30mm Cannon	HS 129	160	30 deg.	57mm
			90 deg.	99mm
		100	30 deg.	58mm
			90 deg.	100mm
		200	30 deg.	55mm
			90 deg.	98mm
Kw.K.38t 37mm Cannon	JU 87G	300	30 deg.	70mm
			90 deg.	100mm
		100	30 deg.	69mm
			90 deg.	140mm
		200	30 deg.	65mm
			90 deg.	134mm
Kw.K.40 75mm Cannon	HS 129	300	30 deg.	60mm
			90 deg.	123mm
		100	30 deg.	95mm
			90 deg.	120mm

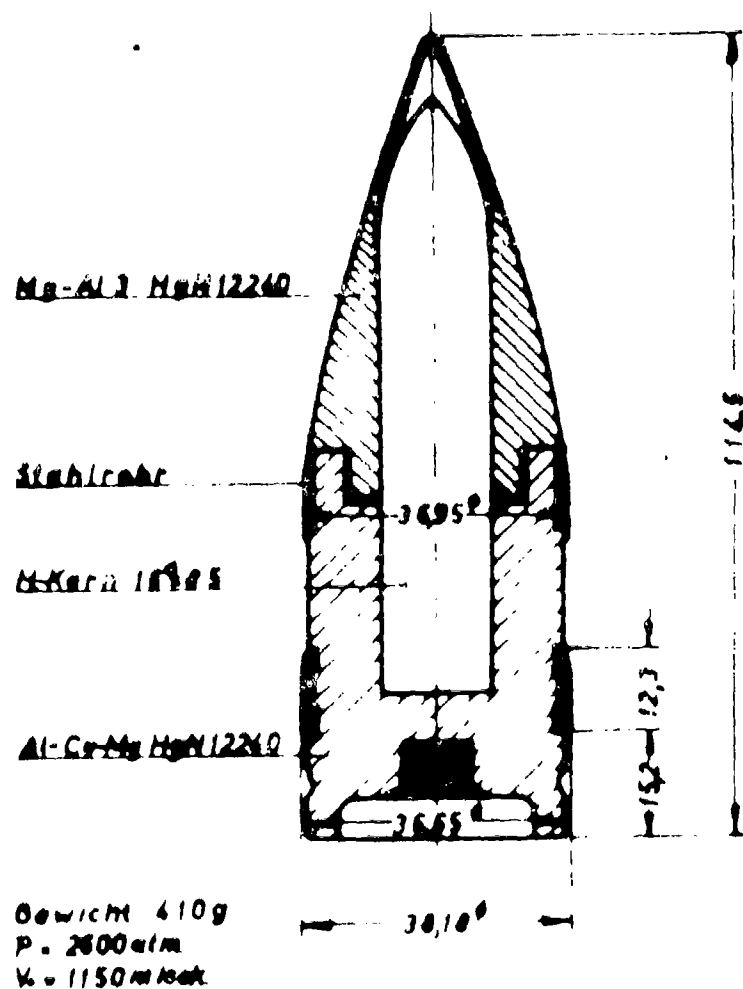
Source: Karlsruhe Document Collection (K113.3019-3/frame 1826)

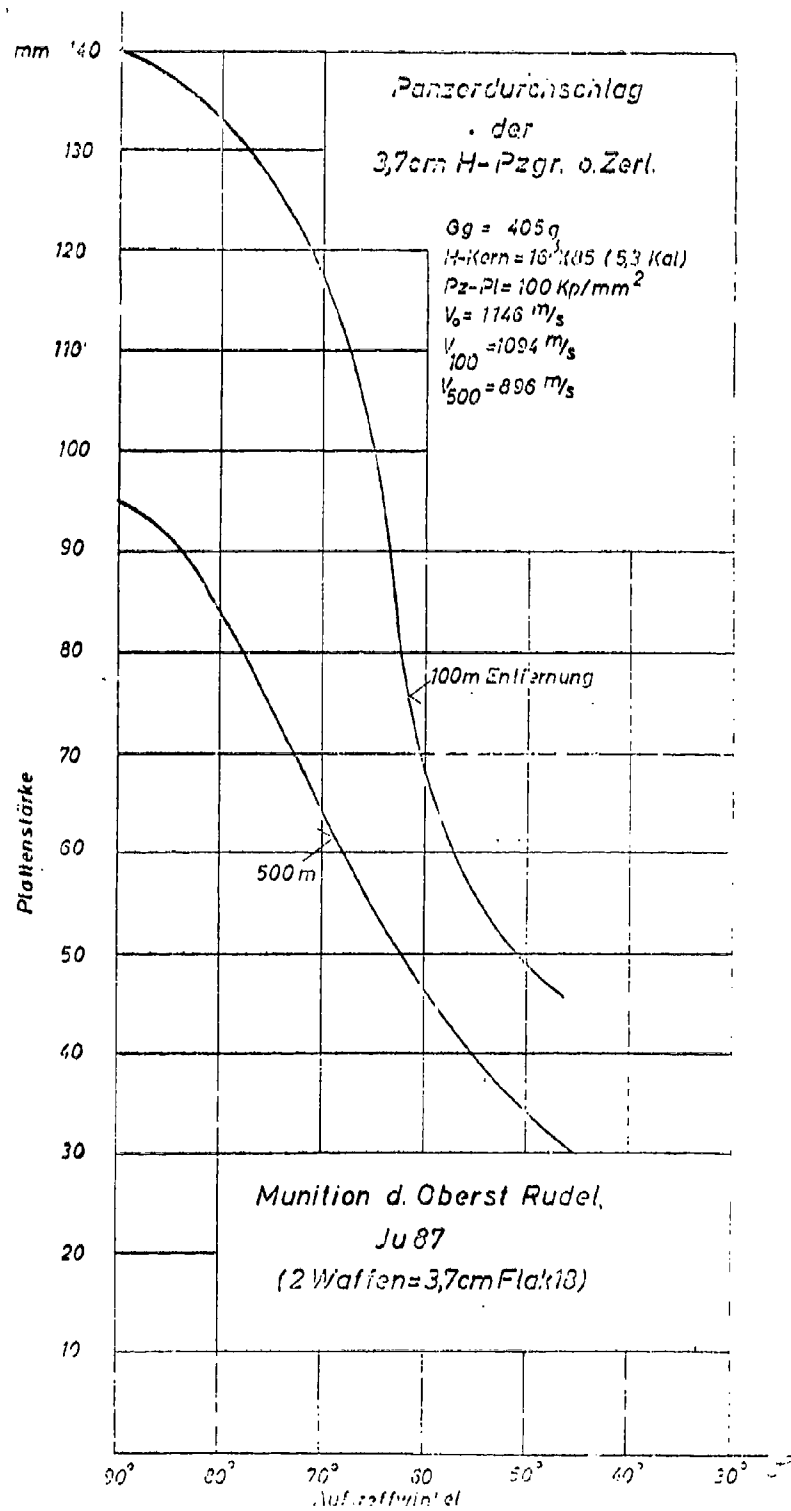
APPENDIX IV

Characteristics of Oberst Rudel's 37mm Ammunition
and Comparison to 30mm Armour Piercing GAU-8 Ammunition

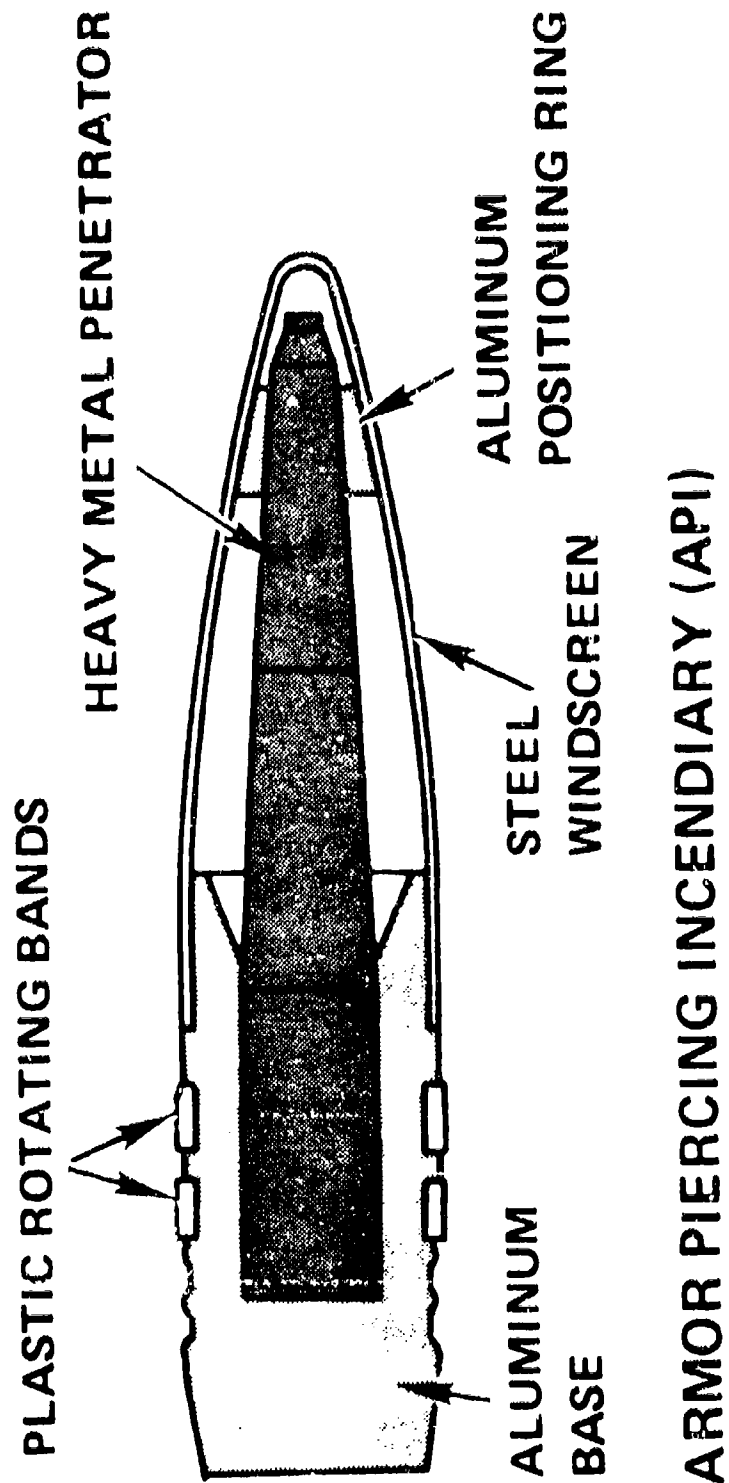
3.7 cm H-Pzgr. LapucaZerl.

11302201





Oberst Rudel's 37mm



The GAU-8 30mm API Round

APPENDIX V

Order reorganizing Stukageschwader into Schlachtgeschwader

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Generelle Kommandoebene

Luftflottenkommando 5 St.Qu., den 22.10.43
O.Qu.Nr. 2513/43 g.Kdos.Ib 21 Ausfertigungen
Az. 11 b 16 11 Ausfertigung.
Betr.: Umorganisation der Schlachtverbände.

Gemäss D.R.d.L.u.Ob.d.L., Genst.Gen.Qu.2.Abt.Nr.11125/43
g.Kdos.(II A) vom 5.10.43 ist befohlen:

- 1.) Mit sofortiger Wirkung wird die
I./Sturzkampfgeschwader 5 in
I./Schlachtgeschwader 5
umbenannt und zu einem später noch zu befehlenden Zeit-
punkt umgegliedert.
- 2.) K.St.N. gemäss Liste der Einheiten
für Gruppenstab Nr. 1256 (L)
für Stabskompanie Nr. 1258 (L)
für Staffel Nr. 1257 (L)
für Ln.-Kompanie Nr. 3368 (L).
Bis zum Zeitpunkt der Umrüstung behält die bisherige
K.St.N. Gültigkeit.
- 3.) Durchführung der Umbenennung durch Fliegerführer Nord
(Ost) im Benehmen mit General der Schlachtflieger.
- 4.) Besetzung der Planstellen durch vorhandenes Personal
und Material. Zuweisungen durch Ob.d.L. erfolgen nicht.
- 5.) Alle Einzelheiten bezüglich Mob-Hauptlistennummern, Feld-
postnummern sowie Erkennungsmarkenvorzeichnisse regeln
sich nach Verfügung D.R.d.L.u.Ob.d.L., Genst.Gen.Qu.2.Abt.
Nr. 350/42 g.Kdos.(III A1) vom 12.3.42.
- 6.) Mitteilung über erfolgte Umbenennung an den zuständigen
Ersatztruppenteil und an die " Wehrmachtauskunftsstelle
für Kriegerverluste und Kriegsgefangene ", Berlin-W 70,
Hohenstaufenstrasse 47/48 hat durch Fliegerführer Nord
(Ost) über Luftgaustab Finnland zu erfolgen.
- 7.) Kriegsvergliederungs-Basis im Sinne der Bes.Anlage 2 zum
Mob-Plan (L) gehört die I./Schlachtgeschwader 5 zum
Luftgaukommando III.

Ersatztruppenteil ist durch Fliegerführer Nord (Ost)
über Luftgaustab Finnland im Benehmen mit Luftgaukommando
III festzulegen.

- 8.) Die erfolgte Durchführung der Umbenennung der I./Schlacht-
geschwader 5 ist durch Fliegerführer Nord (Ost) zum
30.10.43 an Luftflottenkommando 5 (nachrichtlich an Luft-
gaustab Finnland) zu melden.

Verteiler:

Luftgaustab Finnland	1. Ausf.
Fliegerführer Nord (Ost)	2. "
mit N.A.für	
I./Schlachtgeschwader 5	3. "
Lfl.Kdo.5, Gefechtsstab zgl.f.IIa	4. "
" Ia	5. "
" IIb	6. "
" O.Qu./Qu.1	7. "
" O.Qu./Qu.3	8. "
" O.Qu.z.b.V.	9. "
" HSh.Nafu	10. "
" Chef-Ing.	11. "
" Lfl.Int.	12. "
" U.-u.S.-Stelle	13. "
" K.T.B.	14. "
" O.Qu./16 (Entwurf)	15. "

Umlauf an:

Lfl.Kdo.5, Ia	
" IW	
" Chefriechter	16. "
" Lfl.Arzt	
" O.Qu./Qu.2	
" O.Qu./Mot.	

Nachrichtlich:

Ob.d.L., Gen.d.Schlachtfieger	17. "
Luftgaukommando Norwegen	18. "
Fliegerführer Nord (West)	19. "
Fliegerführer Lofoten	20. "
Jagdfiegerführer Norwegen	21. "

Für das Luftflottenkommando
Der Chef des Generalstabes.

I. A.
gez. R o h d e
Oberst i. Genst.

Für die Richtigkeit

[Signature]
Oberstleutnant

APPENDIX VI

Order renaming Chief of close-air-support units to General der Schlachtflieger

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Luftflottenkommando 5 St.Qu., den 17.10.43. O.Qu.Nr. 11613/43 geh.Ib

Az. 11 b

Bezug: Lfl.Kdo.5, O.Qu.Nr. 10387/43 geh.Ib

19.9.43
Fliegerangebuch

Betr.: Umbenennung der Dienststelle General der Nahkampfflieger

Gemäss Verfügung D.R.d.L.u.Ou.d.L., Genst.Gen.Qu.2.Abt.
Nr. 5030/43 geh.(I) vom 7.10.43 führt ab sofort die Dienst-
stelle des

General der Nahkampfflieger

die Bezeichnung

General der Schlachtflieger (Gen.d.Schlachtfli.).

O.a.Bezugsverfügung ist entsprechend handschriftlich zu be-
richtigen.

Verteiler:

Luftgaukommando Norwegen
Luftgaustab Finnland
Fliegerführer Nord (West)
Fliegerführer Nord (Ost)
Fliegerführer Lofoten
Jagdfliegerführer Norwegen
Lfl.Kdo.5, Ia

"	Ia	} Umlauf
"	Ib	
"	O.Qu./Qu.2	
"	O.Qu./z.b.V.	
"	HöH.Wafu	
"	Chef-Ing.	
"	K.F.B.	
"	O.Qu./Ib (Entwurf)	

Für das Luftflottenkommando
Der Chef des Generalstabes.

I. A.

gez. R o n d e
Oberst i.Genst.

Für die Richtigkeit

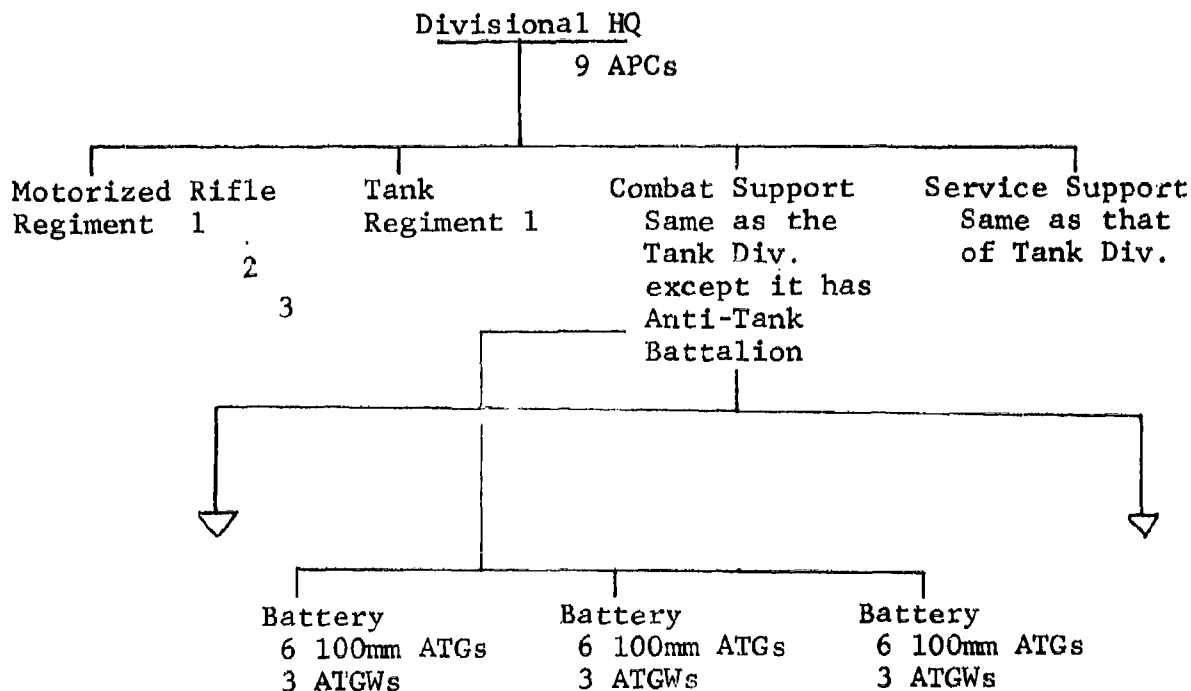
Oberstleutnant

APPENDIX VII

Soviet Divisional Strength

Source: Erickson, John, Soviet-Warsaw Pact Force Levels,
USSI Rpt 76-2.

SOVIET MOTORIZED RIFLE DIVISION

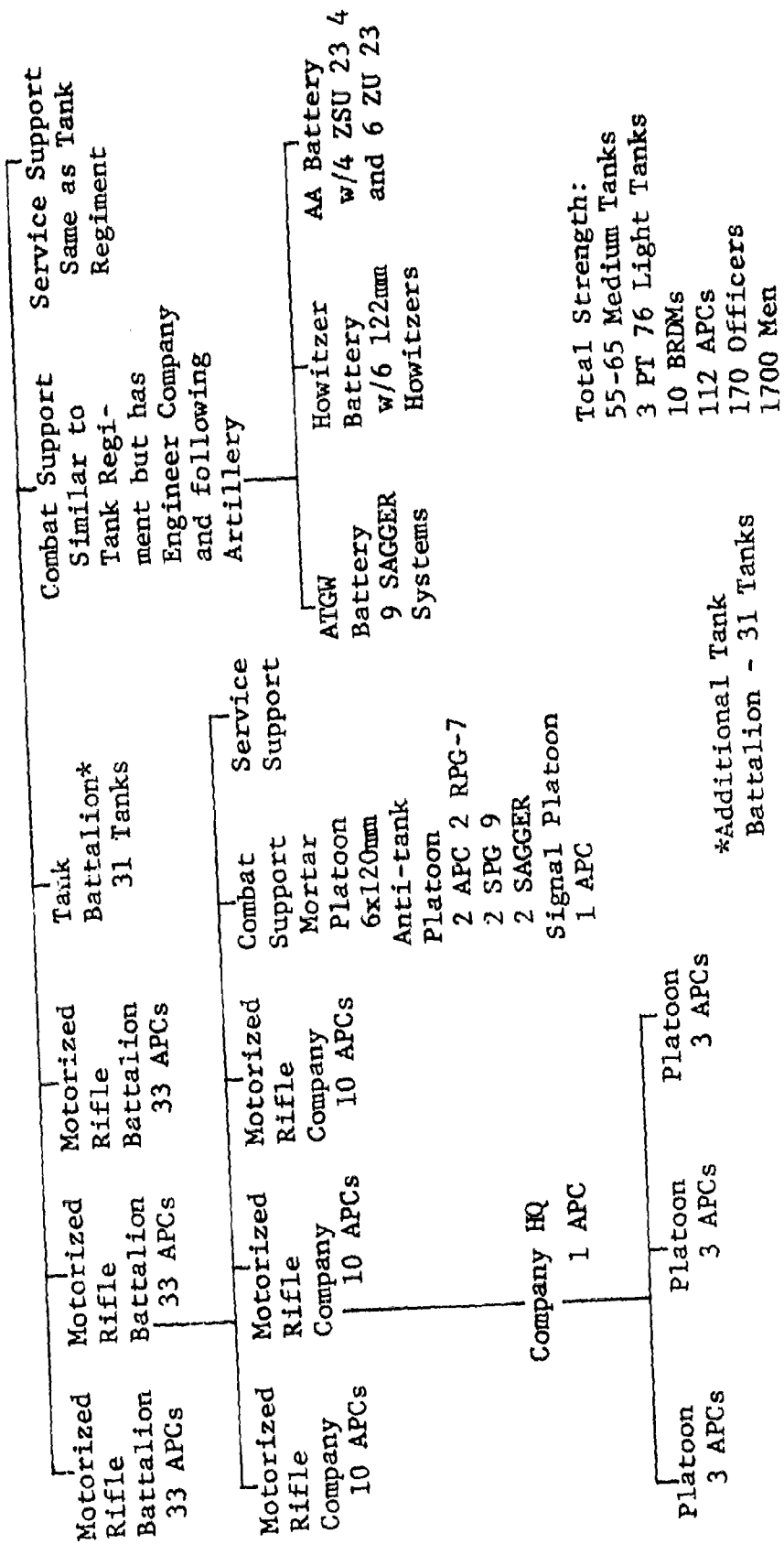


Total Strength:
225-260 Medium Tanks
19 PT 76 Light Tanks
73 BRDMs
372 APCs
1100 Officers
9700 Men

SOVIET MOTORIZED RIFLE REGIMENT

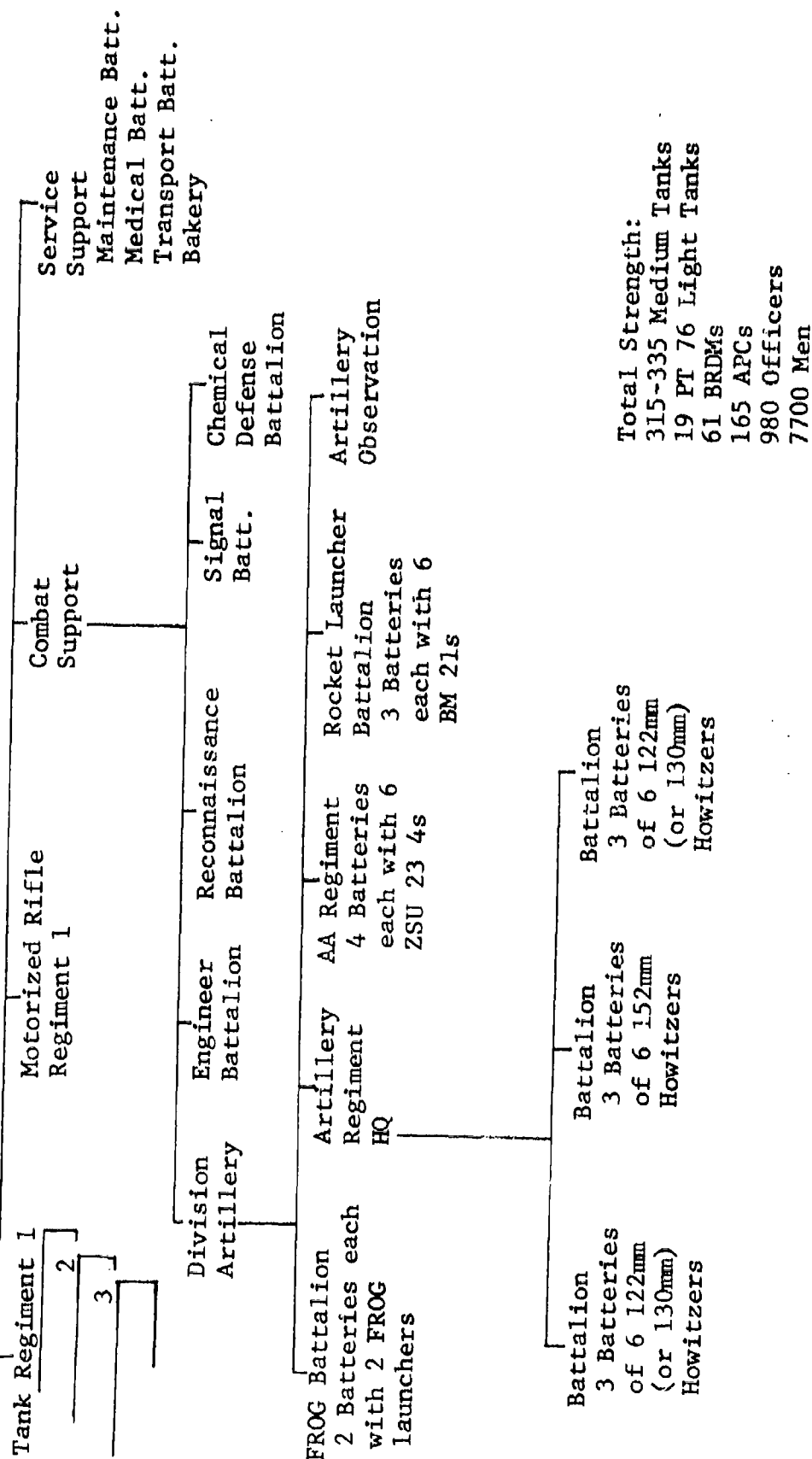
Regimental HQ

3 APCs



SOVIET TANK DIVISION

Tank Division HQ

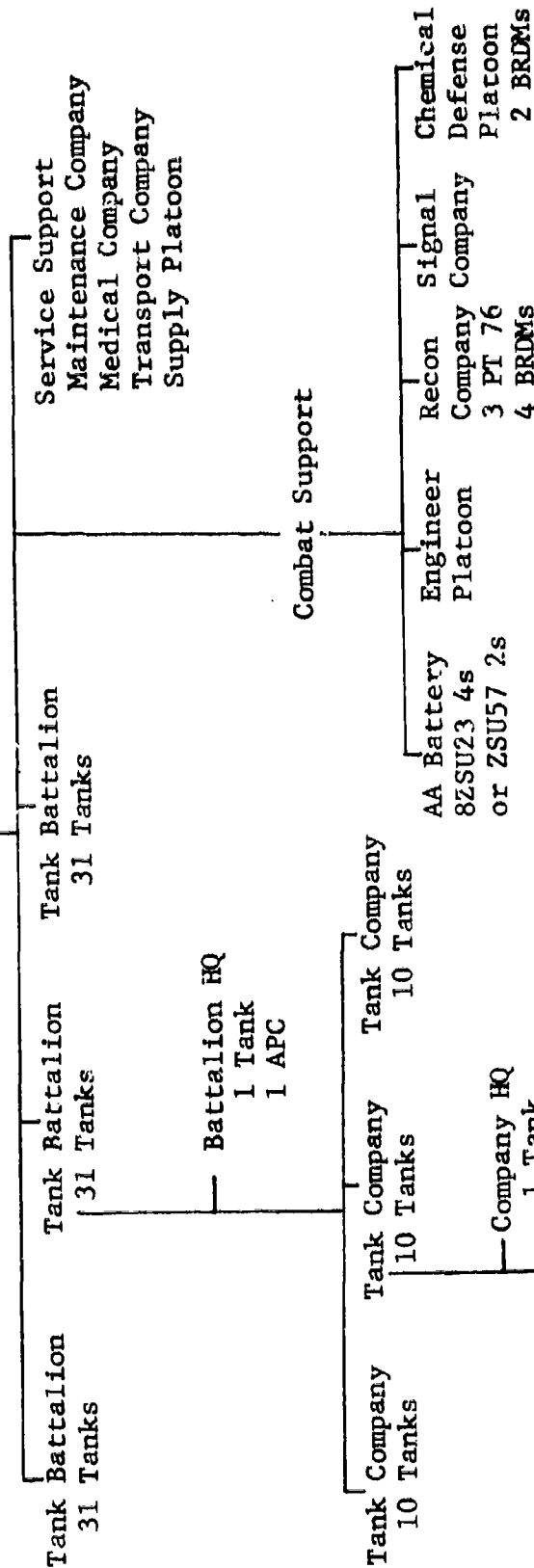


Total Strength:
 315-335 Medium Tanks
 19 PT 76 Light Tanks
 61 BRDMs
 165 APCs
 980 Officers
 7700 Men

SOVIET TANK REGIMENT

Regimental HQ

2 MBTs
2 APCs

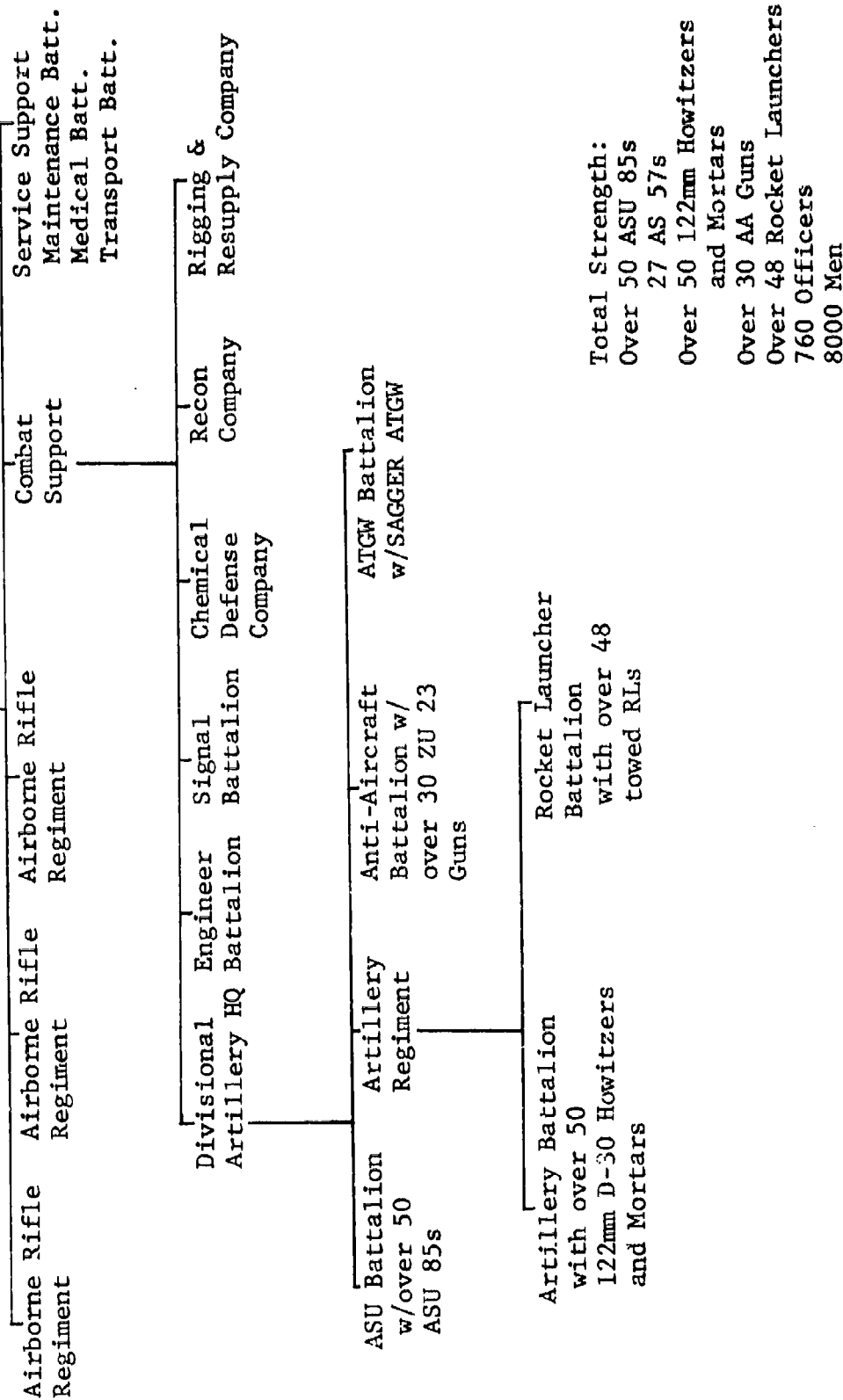


Total Strength:

110-120 Medium Tanks
3 PT 76 Light Tanks
6 BRDM Reconnaissance Vehicles
8 APCs
130 Officers
800 Men

SOVIET AIRBORNE DIVISION

Divisional HQ



APPENDIX VIII

The Order of the Iron Cross, World War II

The Order of the Iron Cross is awarded in the following sequence:

1. The Iron Cross, 2d Class
2. The Iron Cross, 1st Class
3. The Knight's Cross to the Iron Cross
4. The Knight's Cross to the Iron Cross with Oak Leaves
5. The Knight's Cross to the Iron Cross with Oak Leaves and with Swords
6. The Knight's Cross to the Iron Cross with Oak Leaves and Swords and Diamonds
7. The Knight's Cross to the Iron Cross with Golden Oak Leaves and Swords and Diamonds
8. The Great Cross of the Iron Cross

NOTE:

The #3 award, the Knight's Cross, was won by approximately 7500 military men.

The #4 award, The Oak Leaves, was won by 860 military men.

The #5 award, The Swords award, was won by 154 military men.

The #6 award, The Brilliants (or Diamonds), was won by 27 military men.

The #7 award, with Golden Oak Leaves, was won only by famed Stuka pilot Hans Ulrich Rudel.

The #8 award, The Great Cross, was issued only to Reichsmarschall Hermann Goering.

Approximately 1730 Luftwaffe personnel won The Knight's Cross. 192 won The Oak Leaves.

41 won The Oak Leaves and Swords.

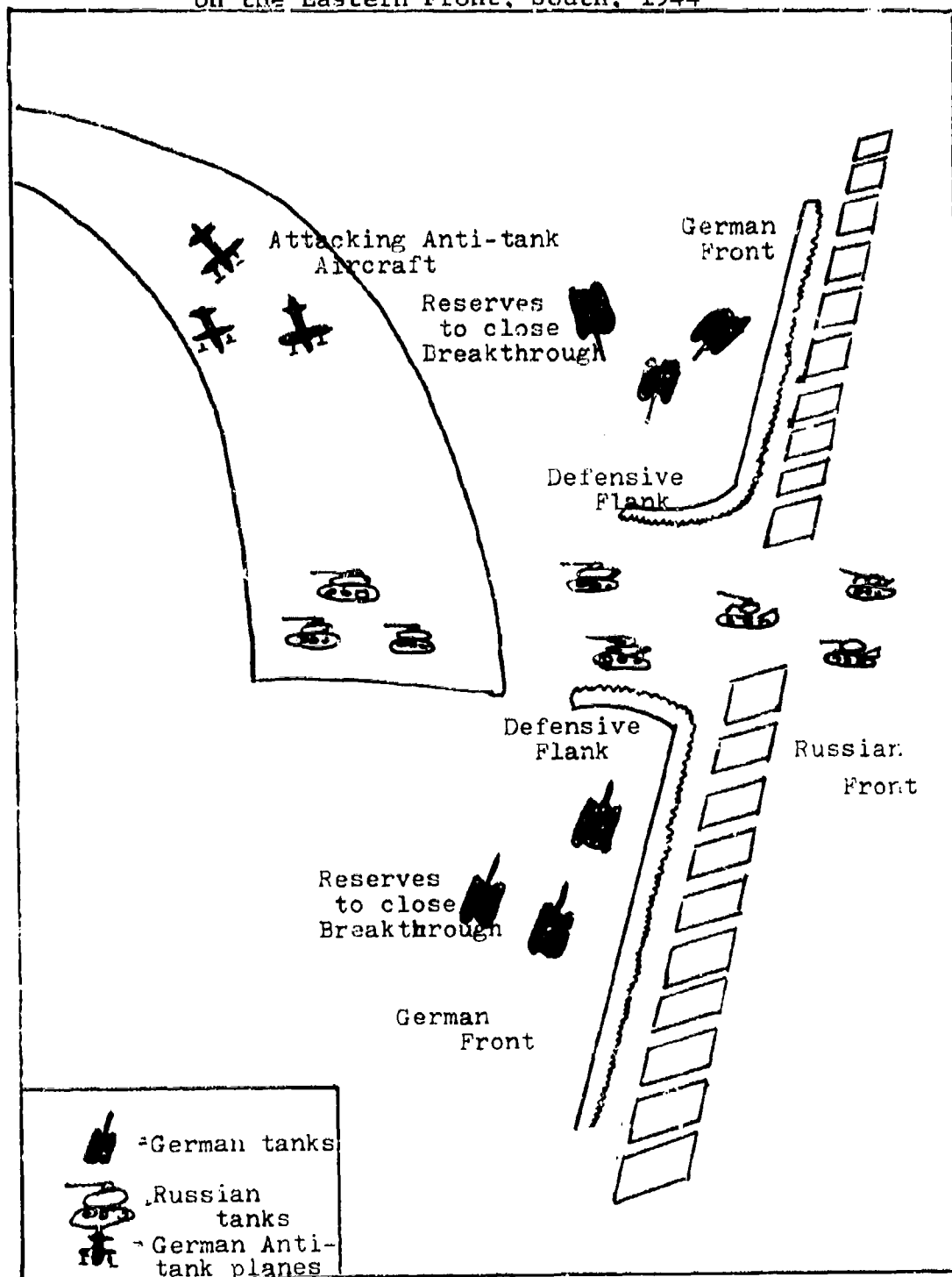
10 won The Oak Leaves, Swords and Diamonds.

1 won The Golden Oak Leaves, Swords and Diamonds (Rudel).

1 won the Great Cross of the Iron Cross (Goering).

APPENDIX IX

Schematic Presentation of Control of an Armoured Breakthrough on the Eastern Front, South, 1944



APPENDIX X

Interview Brigadegeneral a.D. Paul-Werner Hozzel

MEMORANDUM FOR RECORD

4 July 1976

Subject: Interview with Brigadegeneral a. D. Paul-Werner Hozzel. Interview held at Karlsruhe, West Germany on 24 June 1976 from 1000 hours to 1230 hours and from 1430 hours to 1630 hours. Conducted in German.

Personal data: General Hozzel entered military service in 1931. He volunteered for pilot training, and transferred to the Luftwaffe. He attended pilot training, instrument flying training, dive bomber school and fighter school. His war service included posting as Staffelkapitän, Gruppenkommandeur, and Geschwaderkommodore. In March 1943 General Hozzel was posted to a logistics command covering the Crimea, Black Sea and Kuban areas. In January 1944 he attended an abbreviated General Staff course at the Kriegsakademie in Berlin. From the Kriegsakademie he was assigned to the Staff of Luftflotte 1 (Kurland) where he ended the war as Chief of Staff Luftflotte 1 with the rank of Oberstleutnant i.G., although the position called for a General Officer. For the next eleven years General Hozzel was a Russian POW. Decorations include the Oak Leaf to the Knights Cross of the Iron Cross. After return

to the Bundesrepublik, General Hozzel entered the new Luftwaffe as an Oberstleutnant and retired in 1969 as a Brigadegeneral. Today General Hozzel is employed by an administration academy in Karlsruhe, West Germany.

THE INTERVIEW

Question: In general how effective were the Schlachtgeschwader in anti-tank defense?

Answer: Good. My personal experience was only with bombing and not the cannon equipped JU87G. Due to slow speed, poor aerodynamics and limited maneuverability the JU87G could not operate far behind the enemy front. The JU87G was normally only used for attacks against tanks that had broken through the front lines. With regard to bombing tanks, we used the 250 kilogram bomb with the Panzerbrecherkopf (tank busting head) or the 250 kilogram Flammбомbe (similar to napalm). These were used very successfully in the initial battle for Stalingrad in Sept-Oct 1942, where I commanded 4 Stukagruppen working with the 6th Army of Generaloberst Paulus. In delivering these bombs the attack would start at 1000 meters altitude. Deliveries for the bombs would be in a 30 to 45 degree dive angle and a release on sight picture. It was necessary to be very exact in the delivery as the bomb would have to impact under the enemy tank to effect a kill.

Question: Generalleutnant Plocher has said that anti-tank defense was the most important task of the Luftwaffe after the autumn of 1943; however, there were few aircraft available for that specific purpose. Can you clarify this point?

Answer: I agree with the exception of one fighter bomber Geschwader Fock-Wulf 190, there was not an aircraft in existence at that time that was capable of operating behind the front. I have already pointed out the problems with the JU87G.

Question: Aircraft production in 1944 exceeded 40,000 units, yet you mention shortages at the front. What happened to all of these aircraft?

Answer: I am not certain about your figure of 40,000 aircraft being produced in 1944. I am giving you a picture of reality at the front as a Staffelkapitän, Gruppenkommandeur, and Geschwaderkommodore, if we had had those 40,000 aircraft at the front we would not have lost the war. Losses were quite heavy in combat and accidents. For example, I was a commander of 2 Gruppen at the battle of Moscow in 1941, from these 2 Gruppen with a nominal strength of 100 aircraft we could put only 3 to 6 into the air each day, by open fires, as the engine heaters were frozen in the mud. Were it not for the weather and associated maintenance problems, we would have taken Moscow in November/December 1941.

Question: When you encountered heavy Flak, what tactics would you use in attacking armoured forces?

Answer: We would use Flak elimination forces to keep down the Flakpanzer and attack the main combat tank force at the same time.

Question: Could you explain the normal training requirements for a Schlachtflieger?

Answer: After basic pilot training the selectee would attend a 3 month course in dive bombing at a dive bomber school. Then he would attend 3 months of supplementary (Ergänzung) training with advanced tactics and exercises including training with other friendly aircraft simulating enemy tactics in a supplementary squadron. After posting to an operational unit the new Schlachtflieger would be a wingman (Kettenhund) for 20 or more combat sorties before being considered operationally ready, and before being considered for a flight lead position.

Question: What was the normal crew complement of a Schlachtfliegergruppe?

Answer:

- 1 Commander (Major or Oberstleutnant, or an exceptional Hauptmann)
- 20 Officers (pilots)
- 30 Enlisted (pilots)
- 50 Bordfunker/Bordschützer (Backseaters of the Stuka)

Question: In general how would you rate the quality of the Schlachtflieger? Did you usually receive the "washouts" from fighter training?

Answer: No! Especially not in the beginning. In order to withstand the physical demands of flying the Stuka (we had no "G" suits in those days you know) a pilot would have to undergo a very detailed special medical examination. A few pilots like myself constituted an elite force as we had training in fighters, dive bombers, weather, and advanced tactics schools. Toward the end of the war, however, we would receive replacements of personnel who had only had training in the aircraft that they would fly in combat. As to the quality of the pilots, they were excellent especially in the beginning.

Question: Generalmajor Hitschhold has said that the JU87G could no longer be considered a modern combat aircraft in 1939. Are you of the same opinion?

Answer: No, I wouldn't say so. Look at all of the literature that has been written about the Stuka. It was an aircraft sui generis, you cannot compare it with anyone else. The only major defect was that the Stuka was too slow. It was not adequate for operations against the English in the battle of England, but it was perfect against Poland, Norway, France, against sea targets, in the North Africa and Balkans campaigns

and against Russia. In Russia we did not even require fighter cover escort--Russian fighter pilots were not a problem for us. Our training was far superior to theirs, and their tactics and flexibility were inferior. As elite pilots we had no reservations about engaging Russian fighters with our Stukas.

Question: Through your experience with the Russians, how would you rate them as pilots and soldiers?

Answer: Basically the Russians do not require the luxuries of Western Armies. The ground troops were quite strong and could take much punishment. I am not sure if this is a natural quality or if it was enforced by the commissars, the source of their toughness is irrelevant; the fact is that they were tough. They were well disciplined. As far as the pilots; they were perhaps too rigid in tactics and lower echelons did not have the authority to exploit all possibilities. Their view points were too narrow and were without experience throughout the war. I must caution you, however, the Russians of today are not the same as they were in World War II. They have learned much from their experiences and are qualitatively far better than in the last war.

Question: How was your logistics support during the war?

Answer: No problem. With the exception of petrol, we had everything we needed.

Question: How did you handle airfield defense without help from the Army? Did you require additional training in that area?

Answer: No major problems. The Flak units, which were an integral part of the Luftwaffe, were positioned at and around the airfields and were primarily responsible for defense. However, on occasion we were shelled by ground artillery as we were positioned close to the front.

Question: Did you encounter major problems in employing your forces in cold and inclement weather?

Answer: To start with "General Winter" cost us the battle of Moscow. The cold itself was a problem, but more of a problem was the suddenness with which winter struck. We could not use our engine heaters on occasion as they were frozen solid into ground that had previously been mud. We learned from our experiences and subsequent winters were not as difficult for us as the winter of 1941-42 had been, except the situation of Stalingrad where the Luftwaffe was not able to assure the needed logistics support because of the rough weather situation.

Question: What were the normal strengths of a Staffel, Gruppe, and Geschwader?

Answer:

<u>Unit</u>	<u>Aircraft+Res. = Total</u>	<u>Commanded by (exceptional)</u>
<u>Staffel</u>	12 +3 = 15	<u>Hauptmann (Oberleutnant)</u>
<u>Gruppe</u>	3 <u>Staffeln+Stab(5)</u> = 50	<u>Oberstleutnant, Major,</u> <u>(Hauptmann)</u>
<u>Geschwader</u>	3 <u>Gruppen+Stab(3)</u> = 153	<u>Oberst, Oberstleutnant,</u> <u>(Major)</u>

Question: How would you rate the German Luftwaffe today?

Answer: One cannot expect that spirit of national enthusiasm today, that motivated the Luftwaffe in the years of victories in World War Two. The spirit of today's Luftwaffe is not emotional. The pilots of today are realists. They are much more moderate (in German we call it nüchtern). They are not so intensive as we the generation of World War Two were. For the one it may be a job with all risks, for the other a new personal engagement. But whatsoever they may feel they will do their duty and fight for the freedom of the Free World with the same bravery as we did when we fought for our national freedom to correct the Treaty of Versailles.

With the tremendous losses and sufferings after the last war the German people lost themselves in work to build up again their fatherland. So it seems explainable that they didn't like to hear anymore of war, of soldiers, of a new army. Soldiers mean war they said and so they refused the formation of a new Wehrmacht, the Bundeswehr. In many parts of the thinking population the opinions seem to have changed in favor of the Bundeswehr, but there are still lots of people who consider the Bundeswehr and NATO as necessary evils.

Question: What can NATO do to increase its effectiveness today?

Answer: Make it stronger. More conventional power in addition to nuclear superiority. First of all military integration

of all NATO partners without any exceptions and rigorous standardization of weapons is vital. I deeply regret the disengagement of the French having left the military integration of NATO. Opposite the Eastern Threat which is indivisible, we need a complete integrated European Army. Every responsible leader of the Free World is in the position of having to deal with a sudden conventional attack of the Warsaw Pact against Western Europe believe it or not. Then it would be too late for any re-integration of a whole national army like the French one. For the time being we can hope that the Chinese threat is still a restraint for the Russians to keep clear of any adventures towards the West. But how long? What will happen after Mao? Perhaps appeasement between the two communists blocks and new friendship! We in the West do have still an advantage over the Russians in technology. But one day this may drop as well.

Question: Did you have enough officers in the last war with general staff training?

Answer: Yes and no. The Führungsstab der Luftwaffe was interested in 1943 to put Gruppenkommandeure and Geschwaderkommodore with much combat experience into General Staff positions of the higher staff levels as there are Division, Korps or Luftflotten (which is army level). This was what happened to me (and other commanders) as a Geschwaderkommodore

in spring 1944 after having absolved an abbreviated General Staff Course at the Luftkriegs Akademie in Berlin. Only the fighter commanders tried to escape this trend with success. This is the reason that later in the course of the war we had a need of General Staff officers with fighter combat experience.

APPENDIX XI

Interview Oberst a.D. Hans-Ulrich Rudel

MEMORANDUM FOR RECORD

5 July 1976

Subject: Interview with Oberst a.D. Hans-Ulrich Rudel.

Interview conducted at Chicago, Illinois on 28 June 1976.

Interview conducted in German.

Personal Data: Oberst Rudel entered the armed service at the Wildpark-Werder Military School in December 1936. He was commissioned in December 1938 upon completion of Stuka training. He received further training in Reconnaissance School. The outbreak of the war with Poland in 1939, he was in a reconnaissance squadron. Oberst Rudel was later transferred to Stukas where he subsequently served as a Staffel, Gruppe and Geschwader commander. He is Germany's highest decorated soldier; the only recipient of the Golden Oakleaf with Swords and Diamonds to the Knight's Cross of the Iron Cross. He destroyed 519 Russian tanks with the JU87G carrying two 37mm cannons. Oberst Rudel was shot down by Flak over 30 times during the war and had his right leg amputated after being severely wounded in 1945. After the war he lived in Argentina and then returned to Germany. He is currently active in numerous business concerns and makes his home in Kufstein, Austria.

INTERVIEW:

Question: In general, how effective was the JU87G with the two 37mm cannons against enemy tanks?

Answer: Theoretically of course, one could not work too far behind the front--usually 10, 20 or 30 kilometers. However, it was very individual the way in which we operated. In my case ideally, I had two FW190s to suppress Flak while I would attack the enemy tanks with the JU87G. However, often we did not have the Flak suppression aircraft and we worked with what was available. Effectiveness was also an individual matter, for example, I was the top "Tank Killer" with 519 total kills. The next three pilots had 100, 70, and 60, respectively.

Question: What specific tactics would you use in attacking tanks?

Answer: You must understand that the JU87G was a very difficult aircraft to fly and we lost many pilots while they were attacking tanks, as they simply did not have the experience to employ the JU87G most effectively and survive. My basic tactic would be an attack altitude of about 800 meters and an attack speed of 320-340 kilometers per hour, with a dive angle of about twenty degrees and a firing slant range of 100 to 200 meters. However, the above figures are only rough ones. What I would do would be to roll in for an attack, then

jink very severely to avoid Flak and the last moment roll out and fire. If I missed the tank I would adjust the aim point for the next pass. My sight picture was obtained by a "seat of the pants" feeling that I acquired by experience. We lost most of our anti-tank pilots to Flak when they would make a long pass for aiming at the tank and naturally flying a straight flight path. The gunners on the ground would shoot us down during this critical phase of flight. Only the most experienced pilots could fly the JU87G. Each 37mm cannon weighed 420 kilograms, the landing speed was 180 kilometers per hour versus the normal Stuka with 140 kilometers per hour. Additionally one could not pull as many "G's" and the aircraft was not aerodynamically sound. We had no aircraft that could be used in mass with relatively inexperienced pilots. It was a very individual matter how one would attack a tank. We had many losses at first especially during the tracking phase of attack.

Question: Did you encounter any significant problems in coordinating air operations with the Army?

Answer: No, coordination through radio with ground troops worked quite satisfactorily. We also used a Luftwaffe officer, who was detailed to the Army. He would always be co-located with the ground personnel at the very front lines and would act as a liaison man as well as coordinating actual air strikes.

Question: Did you have any serious logistics problems?

Answer: No, in principle we had everything we needed. Seldom did we lack for munitions. Fuel was a problem, especially later in the war, but that was a production problem, not a logistics one.

Question: Was weather a problem?

Answer: Yes! The suddenness with which severe weather would come was a shock. Aircraft maintenance had to be increased, for example a normal Stuka engine life before overhaul was 100 to 150 hours, in the severe cold of the Russian winter the engines would last only 40 to 45 hours.

We naturally had to preheat our aircraft engines -- it was so difficult on occasions we developed the policy of "it will either start up or burn up." The cold of 40 to 50 degrees under zero centigrade even caused the hydraulic fluid and lubricants to freeze. On occasion our ground personnel would stay up all night and start the aircraft engines at half hour intervals so as to have them ready for the first sorties in the morning.

As for personnel we lived about 50% of the time in bunkers and 50% in native huts. The native housing was however usually lice infested. We had to de-lice these quarters before they could be used. The poorer class of Russians were very primitive.

Question: Did you have any special measures for airfield defense?

Answer: No. Defense was the responsibility of the host company. The Luftwaffe had its own Flak troops who usually had no problem in handling airfield defense. On occasion we would augment these forces in the case of a Russian attack, but this was not the norm.

Question: To what do you attribute the success of the Luftwaffe in the last war, especially considering the inferiority of your numbers?

Answer: The Wehrmacht owed its successes to many factors. We had a tremendous will and dedication. Local commanders had the authority to conduct operations as they saw fit. Individual units were given assignments and how they carried it out was generally their business. Our personnel were highly trained and our equipment generally superior.

Question: Can you explain the characteristics of Russian soldiers in the last war? What were their good points? What were their bad points?

Answer: Of the pilots, 5% were good, the so-called Stalin-geschwader. The other 95% were average. They were very brave but did not show much flexibility. The ground troops were very numerous, brave and did not require much support. In spite of their good points, the Russians would have never

gotten to Germany without American help. While we in Germany had many fine weapons, especially the Panther and Tiger tanks, we lost all of our good people. We could not replace the core of experience that we lost with our elite personnel.

Question: What do you consider the strong and weak points of NATO today and how can it be improved?













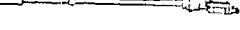

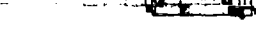
Answer: If you want to make NATO stronger, make it like the Wehrmacht was in 1940. If the Russians attack today, it will take them 2 days to get to the English Channel. Today the Bundeswehr is not 1/1000 what the Wehrmacht was. The U.S. is preoccupied with domestic problems of Race, unemployment and your economy. Can the U.S. concentrate on Europe? I don't have much faith in NATO.

Question: Did you consider physical conditioning of your pilots an important factor in success?

Answer: Most emphatically yes! On one occasion I flew 17 sorties in one day and days of a dozen sorties per man were not uncommon. During periods of intense activity, the first sorties would launch at 0300 hours and the last launch at 2200 hours. We would rest underneath our aircraft between flights. I would personally take a 10 km run every day. We organized sports events within the unit on a daily basis.

APPENDIX XII

Comparison of Airborne Cannon Systems

1/40 Scale Gun	Designation	Caliber MM	Action	No. of Barrels	Firing Rate SPM	Overall Length In.	Installed Weight Lbs.	Round Unit Wt. Lbs.	Feed System	Muzzle Parameters		
										Velocity FPS	Kinetic Energy Kft-Lbs.	Muzzle Kft-Lbs.
	GAU-6	12.7	Gatling	6	8000	48	130	0.30 0.26	Linked Linkless	3450	17.2	4
	MK-39	20	Revolver	1	1600	72.4	179	0.68	Linked	3250 3550	36.1 36.4	1.75
	M61A1	20	Gatling	6	7200	72	252	0.68 0.57	Linked Linkless	3380 3700	39.0 39.5	8.52
	Advanced Lightweight Gun	20	Gatling	3	4000	73	130	0.53	Linkless	3700	39.5	4
	Improved Gatling	25	Gatling	6	4200	90.5	298	1.11	Linkless	3600	79.9	10
	PFB-25	25	Recip.	1	600	113.7	247	1.30	Linked	3612	80.4	1
	Advanced Lightweight Gun	25	Gatling	3	3000	92	160	1.11	Linkless	3600	79.9	7
	Mauser MK-27	27	Revolver	1	1700	71	216	1.27	Linked	3440	104.9	9
	Aden	30	Revolver	1	1250	65.4	177	1.22	Linked	2627 2381	55.7 52.2	2.11
	DEFA 553	30	Revolver	1	1500	81.5	189.5	1.12	Linked	2740 2660	60.6 58.2	2.76
	XM-188 DEFA	30	Gatling	3	2000	59	200	1.12	Linked			
	GAU-8	30	Gatling	7	4200	112.5	600	1.50	Linkless	3450 3250	145.3 154.7	18.4
	GAU-9	30	Revolver	1	1350	106	286	2.18	Linked	3382	141.0	?
	Mauser Model F	30	Recip	1	800	126.3	435	2.18	Linked	3300	132.9 141.6	3.22
	Advanced Lightweight Gun	30	Gatling	3	2000	113	265	1.50	Linkless	3450 3250	145.3 154.7	8.86

Gannon Systems

2

No. of Barrels	Firing Rate SPM	Overall Length in.	Installed Weight Lbs.	Round Unit Wt. Lbs.	Feed System	Muzzle Parameters			Recoil-Lbs		Dispersion 80% Uninstalled	REMARKS
						Velocity FPS	Kinetic Energy Kft-Lbs.	Horsepower Kft-Lbs/Sec.	Peak	Steady State		
6	8000	48	130	0.30 0.26	Linked Linkless	3450	17.2	4.17			6 M11	
1	1600	72.4	179	0.68	Linked	3250 3550	36.1 36.4	1.75 1.76			4 M11	M50/Improved Not included in study matrix due to low muzzle energy -- F-5E Gun
6	7200	72	252	0.68 0.57	Linked Linkless	3380 3700	39.0 39.5	8.52 8.63			6 M11	M50/Improved Present F-16 PSD Gun @ 6000 spm
3	4000	73	130	0.53	Linkless	3700	39.5	4.79				G.E. Proposal
6	4200	90.5	298	1.11	Linkless	3600	79.9	10.17				G.E. Proposal
1	600	113.7	247	1.30	Linked	3612	80.4	1.46	7700	5000	1 M11	Added to study matrix due to high muzzle energy. Only gun currently firing the Bushmaster Round
3	3000	92	160	1.11	Linkless	3600	79.9	7.26				G.E. Proposal
1	1700	91	216	1.27	Linked	3440	104.9	5.40				Not a NATO standard cartridge. Included in study matrix prior to NATO standardization. Ref. Only -- MICA Gun
1	1250	65.4	177	1.22	Linked	2627 2381	55.7 52.2	2.11 1.98			14+ M11	HEI/SAPI Out of production since 1971. Reference Only -- Harrier Gun
1	1500	81.5	189.5	1.12	Linked	2740 2660	60.6 58.2	2.76 2.65			3 M11	A-A/A-G -- Mirage, Jaguar Gun
3	2000	59	200	1.12	Linked							Proposed for Advanced Attack Helicopter (AAH)
7	4200	112.5	600	1.50	Linkless	3450 3250	145.3 154.7	18.49 19.68		8000		HEI/API -- A-10 Gun
1	1350	106	286	2.18	Linked	3382	141.0	5.77	11,000		2 M11	-- Vigren Gun
1	800	126.7	435	2.18	Linked	3300	132.9 141.6	3.22 3.43	5300		1 M11	HEI/API Not included in study matrix due to weight and mounting requirements
3	2000	113	265	1.50	Linkless	3450 3250	145.3 154.7	8.80 9.37				HEI/API G.E. Proposal

BIBLIOGRAPHY

Books:

1. Baumbach, Oberst a.D. Werner, The Life and Death of the Luftwaffe, New York: Coward-McCann, Inc., 1949.
2. Bekker, Cajus, The Luftwaffe War Diaries, New York: Doubleday and Company, 1964.
3. Caidin, Martin, The Tigers Are Burning, New York: Hawthorn Books, Inc., 1974.
4. Carell, Paul (pseudonym), Unternehmen Barbarossa, Frankfurt: Ullstein GmbH, 1963.
5. _____, Scorched Earth, The Russian-German War, 1943-44, Boston: Little, Brown and Company, 1970.
6. Craig, Gordon A., The Politics of the Prussian Army, 1640-1945, New York: Oxford University Press, 1956.
7. De Blij, Harm J., Systematic Political Geography, New York: John Wiley and Sons, Inc., 1967.
8. Enrico, Po, Tanks of the Great Armies, Genoa: Interconair S.A., 1969.
9. Fest, Joachim C., Hitler, New York: Harcourt Brace Jovanovich, Inc., 1973.
10. Galland, Generalleutnant a.D. Adlof, Ries, K. & Ahnert, R., The Luftwaffe at War, 1939-1945, London: Ian Allen, 1972.
11. Green, William, The Warplanes of the Third Reich, New York: Doubleday and Company, Inc., 1970.
12. Guderian, Generaloberst a.D. Heinz, Panzer Leader, New York: E.P. Dutton and Company, Inc., 1952.
13. Hart, Captain Sir Basil Henry Liddell, The German Generals Talk, New York: William Morrow and Company, 1948.

14. _____, History of the Second World War, New York: G.P. Putnam's Sons, 1970.
15. _____, Strategy, New York: Praeger, 1967.
16. Hoffschmidt, E.J. and Tatum, W.H. IV, Tank Data II, Old Greenwich: We Inc., 1969.
17. Hunter, Holland, Soviet Transport Experience, Its Lessons for Other Countries, Washington, D.C.: The Brookings Institution, 1968.
18. Irving, David, Die Tragödie der Deutschen Luftwaffe, Frankfurt: Verlag Ullstein GmbH, 1970.
19. Jane's All The World's Aircraft, (edited by John W. R. Taylor) London: Jane's Yearbooks, 1975.
20. Just, Günther, Stuka-Oberst Hans-Ulrich Rudel, Stuttgart: Motor Buch Verlag, 1975.
21. Keitel, Generalfeldmarschall Wilhelm, The Memoirs of Field-Marshal Keitel, (edited by Walter Gorlitz) New York: Stein and Day, 1966.
22. Lawrence, Richard D. and Record, Jeffrey, U.S. Force Structure in NATO, An Alternative, Washington, D. C.: The Brookings Institution, 1974.
23. Lydolph, Paul E., Geography of the USSR, New York: John Wiley and Sons, Inc., 1970.
24. Macksey, Kenneth and Batchelor, John H., Tank, A History of the Armoured Fighting Vehicle, New York: Ballantine Books, 1971.
25. Macksey, Kenneth, Guderian, Creator of the Blitzkrieg, New York: Stein and Day, 1975.
26. Mahlke, Generalleutnant a.D. Helmut, Nahkampfflieger Verbände, Celle-Westercelle: Schweiger und Pick Verlag, 1971.
27. Manstein, Generalfeldmarschall a.D. Erich von, Lost Victories, Chicago: Henry Regnery Company, 1958.

28. Mason, Herbert Molloy, Jr., The Rise of the Luftwaffe, New York: Ballantine Books, 1973.
29. Mellenthin, Generalmajor a.D. F.W. von, Panzer Battles, Norman: University of Oklahoma Press, 1956.
30. Milsom, John, Russian Tanks 1900-70, Harrisburg: Stackpole Books, 1970.
31. Osterkamp, General der Flieger a.D. Theo, Durch Höhen und Tiefen Jagt Ein Herz, Heidelberg: Kurt Vowinckel Verlag, 1952.
32. Oxford Regional Economic Atlas, The USSR and Eastern Europe, London: Oxford University Press, 1959.
33. Price, Alfred, Bildbuch der Deutschen Luftwaffe 1933-1945, Hamburg: Verlag Gerhard Stalling AG, 1969.
34. Philippi, Alfred and Heim, Ferdinand, Der Feldzug gegen Sowjetrußland 1941-1945, Stuttgart: Kohlhammer GmbH., 1962.
35. Rommel, Generalfeldmarschall Erwin, The Rommel Papers, (edited by B. H. Liddell Hart) New York: Harcourt, Brace and Company, 1953.
36. Rudel, Oberst a.D. Hans-Ulrich, Stuka Pilot, Dublin: Washburn and Sons, Ltd., 1952.
37. Senger und Etterlin, Oberst a.D. F.M. von, Kampfpanzer 1916-66, München: J.F. Lehmanns Verlag, 1971.
38. Shtemenko, S.M., The Soviet General Staff at War 1941-1945, Moscow: Progress Publishers, 1970.
39. Smith, Peter C., Stuka at War, New York: Arco Publishing Company, Inc., 1971.
40. Speer, Albert, Inside the Third Reich, New York: MacMillan Company, 1970.
41. Statesman's Year-Book, Statistical and Historical Annual of the States of the World for the Year 1975-1976, (edited by John Paxton), New York: Saint Martin's Press, 1975.

42. Taylor, John W.R., Combat Aircraft of the World, New York: MacMillan Company, 1970.
43. Tippleskirch, General der Infanterie a.D. Kurt von, Geschichte des Zweiten Weltkrieges, Bonn: Athenaum-Verlag, 1959.
44. Wamliamont, General der Infanterie a.D. Walter, Inside Hitler's Headquarters 1939-45, New York: Praeger, 1962.
45. Weeks, Colonel (retired) John, Men Against Tanks, A History of Anti-Tank Warfare, New York: Mason/Charter, 1975.
46. White Paper 1975/1976, The Security of the Federal Republic of Germany and the Development of the Federal Armed Forces, Bonn: Federal Ministry of Defense, 1975.
47. Wolfe, Thomas W., Soviet Power and Europe, 1945, 1970, Baltimore: The John Hopkins Press, 1970.

Letters:

1. Headquarters USAF Systems Command, Andrews AFB, MD.,
Confidential Letter to ASD/YXM, Wright-Patterson AFB,
OH., Subject: A-10A/GAU-8A Effectiveness, 15 Apr 1975.
2. General Electric Company, Armament Systems Department,
unclassified Letter to Capt. Ratley, Subject: GE
30mm GAU-8 Pod Version, 27 September 1976.
3. General Electric Company, Armament Systems Department,
unclassified Letter to Capt. Ratley, Subject: GE
30mm GAU-8 Pod Version, 1 August 1976.
4. Oberst a.D. Hans-Ulrich Rudel, Kufstein, Austria,
unclassified Letter to Admiral Isham Linder, Subject:
37mm JU87G Cannon, 29 July 1976.
5. Brigadegeneral a.D. Paul-Werner Hozzel, Karlsruhe, West
Germany, unclassified Letter to Capt. Ratley, Subject:
JU87 Stuka, 31 July 1976.
6. Dr. Horst Boog, Freiburg im Breisgau, West Germany,
unclassified Letter to Capt. Ratley, Subject: Stuka
Pilots, 14 May 1976.
7. Herr Noack, Freiburg im Breisgau, West Germany,
unclassified Letter to Capt. Ratley, Subject: Schlacht-
flieger, 31 May 1976.
8. Air University Maxwell AFB, Al., unclassified Letter to
TAC Langley AFB, Va./DR, Subject: Research of WW II
Tactical Air Operations in Europe, 17 December 1975.

Pamphlets:

1. Bateson, Richard P., Profile 211-Junkers JU87D,
Berkshire: Profile Publications Ltd., (no date).
2. Feist, Uwe and Dario, Mike, Luftwaffe in Action Part III,
Warren: Squadron/Signal Publications, 1972.
3. General Dynamics, F-16 Air Combat Fighter, General
Dynamics, 1 September 1975.
4. General Electric, Gun Weapons Systems, General Electric,
1975.
5. Fairchild Republic, A-10, Fairchild Industries, 1975.
6. Identification Guide (Ordnance Equipment) Warsaw Pact
Countries, USA Europe and Seventh Army, USAREUR Pam
30-60-1, July 1968.

Films:

1. SPR 31-76, A-10 Lethality/Combat Ammo Demonstration,
USAF Aerospace Audio-Visual Service, (MAC), 1976.

Special Studies and Research Papers:

1. Stolfi, Professor, R.H.S., Chance in History, The Russian Winter of 1941-42, Naval Postgraduate School, Monterey, 1975.
2. The German Air Force Monograph Project, From the Karlsruhe Collection, Located at the Air University Library, Maxwell AFB, Alabama.

Numbered Studies:

- a. Plocher, Generalleutnant a.D. Hermann, #153 The German Air Force Versus Russia, 1941.
- b. _____, #154 The German Air Force Versus Russia, 1942.
- c. _____, #155 The German Air Force Versus Russia, 1943.
- d. Deichmann, General der Flieger a.D. Paul, #160 German Air Force Operations in Support of the Army.
- e. Nielsen, Generalleutnant a.D. Andreas, #173 The German Air Force General Staff.
- f. Uebe, Generalleutnant a.D., Klaus, #174 Command and Leadership in the German Air Force.
- g. _____, #176 Russian Reactions to German Airpower in World War II.
- h. Suchenwirth, Dr. Richard, #189 Historical Turning Points in the German Air Force War Effort.

Periodicals:

1. Branby, Lieutenant Colonel Harlan E., USAF, "A-10, Tank Killer," USAF Fighter Weapons Review, Winter 75, p. 1-7, December 1975.
2. "Fairchild Republic, A-10: New Thunder for the USAF," Air Combat, Volume 4, Number 3, p. 22-40, May 1976.
3. "Fairchild A-10," Flight International, 24 January 1976.
4. Karber, Phillip A., "The Soviet Anti-Tank Debate," Survival, Volume XVIII, Number 3, p. 105-110, May/June 1976.
5. Meller, R., "Europe's New Generation of Combat Aircraft Part 1, The Increasing Threat," International Defense Review, Volume 8, p. 175-186, April 1975.
6. Powell, Colonel Craig, USAF, retired, "The A-10," Army, March 1976.
7. "USAF Tests A-10 Gun System Lethality," Aviation Week and Space Technology, Volume 104, Number 1, p. 15, 5 January 1976.
8. "USAF Plans A-10 Deployment to Europe," Aviation Week and Space Technology, Volume 104, Number 9, p. 44-47, 1 March 1976.

Technical Reports:

1. LTV Aerospace, Inc., Vought Aeronautics Company, Report Number 2-55300/2R-8619, A-7D 30mm Gun Demonstration Prototype, 14 February 1972, Unclassified.
2. [REDACTED]
3. [REDACTED]
4. [REDACTED]
5. LTV Aerospace, Inc., Vought Aeronautics Company, Report Number 2-14000/4R-10, A-7D Navigation/Weapon Delivery System, Capabilities and Tactical Options, 11 March 1974, Unclassified.
6. [REDACTED]
7. [REDACTED]
8. United States General Accounting Office, Staff Study, A-10 Close Air Support Aircraft, March 1974, Unclassified.
9. United States Strategic Institute, Report Number 76-2, Soviet Warsaw Pact Forces, Erickson, John, P. 41, February 1976, Unclassified.
10. Defense Intelligence Agency, Report Number DDI 1120-129-76, Soviet Tank Company Tactics, May 1976, Unclassified.

11. [REDACTED] O,

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Unpublished Documents and Papers:

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